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National Aeronautics and Space Administration

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VOLUME 3 NUMBER 9

Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N65-18865# ARO, Inc., Arnold Air Force Station, Tenn.
AN EXAMINATION OF FAILING LOADS IN MODEL LAUNCHING EXPERIMENTS
A. J. Cable Arnold Eng. Develop. Center, Mar. 1965 21 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-54; AD-457907)

Evaluation was made of the structural adequacy of the design of a 9° semiangle, blunted cone to be launched from light-gas guns in aeroballistic ranges. Because of the high accelerations of the model necessary if muzzle velocities of interest are to be attained, structural design constitutes a prominent part of the overall problem. Measurements of model accelerations during launch using microwave reflectometers compared favorably with accelerations arrived at analytically, and allowed determination of failing loads during launching. These dynamic loads were correlated with both static compression tests and theoretical estimates. The failing acceleration for 7075-T6 aluminum models ranged from 1.6×10^5g for a 1.75-in. (44.5-mm) caliber cone to 6×10^5g for a 0.45-in. (11.4-mm) caliber cone. Author

N65-18931*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AERODYNAMIC DAMPING AND BUFFET RESPONSE OF AN AEROELASTIC MODEL OF THE SATURN I BLOCK II LAUNCH VEHICLE
Perry W. Hanson and Robert V. Doggett, Jr. Washington, NASA, Mar. 1965 55 p refs
(NASA-TN-D-2713) CFSTI: HC $3.00/MF $0.50

The aerodynamic damping and buffet response of a flexibly mounted 0.08-scale aeroelastic model of the Saturn I Block II launch vehicle were measured at Mach numbers from 0.8 to 1.2. The basic configuration had for the payload an Apollo spacecraft with the launch escape system attached. The effects on the aerodynamic damping and bending-moment response of several modifications to the basic Apollo configuration were investigated. These modifications included the addition of a flow separator to the escape system rocket, removal of the first-stage fins, removal of the launch escape system from the Apollo spacecraft, substitution of a Jupiter nose cone for the Apollo spacecraft and escape system, and the substitution of some modified thin fins for the relatively thick wedge airfoil fins of the basic configuration. The experimentally determined values of aerodynamic damping in the flexible bending modes are compared with theoretical results. The model aerodynamic damping data and the buffet response data are scaled to full-scale values. Author

N65-19155# Lockheed-California Co., Burbank.
WIND TUNNEL TESTS OF AN OPTIMIZED, MATCH-STIFFNESS RIGID ROTOR
John E. Yeates Ft. Eustis, Va., Army Transportion Res. Command, Nov. 1964 64 p
(Contract DA-44-177-AMC-78(T))
(TRECOM-TR-64-56; AD-612011)

A 10-foot-diameter model of a new type of rigid rotor was tested in the Freon atmosphere of a transonic dynamics tunnel at simulated speeds up to 263 mph. Configurations having 3, 4, and 6 blades with zero blade twist and a 4-blade configuration with six degrees of negative twist were tested. A flexure system eliminated the usual feathering bearings. While a true matched stiffness rotor would have flapping and in-plane stiffness matched along the full length of the blade, the system tested had stiffness matched only in the blade flexure region. The tests were successful, and this new type of rigid rotor appears to offer substantial advantages over previous stiff in-plane rigid rotors by reducing rotor weight, gyro weight and drag, hub drag, control forces, and mechanical complexity. Author

N65-19259# David Taylor Model Basin, Washington, D. C. Hydromechanics Lab.
PREDICTION OF THE AERODYNAMIC CHARACTERISTICS OF ANNULAR AIRFOILS
W. B. Morgan and E. B. Caster Jan. 1965 91 p refs
(DTMB-1830; AD-611018)

A computer program is presented which calculates the aerodynamic characteristics of annular airfoils on an IBM-7090 high-speed computer. A brief review of the theory is also presented. Experimental and computer results indicate that the theory gives reasonable prediction of the lift, induced-drag, and moment coefficients and also of the pressure distribution except when separation is present on the annular airfoil. The computer program can also be used for the design of ducted propellers if an infinite number of blades is assumed. Author

N65-19276*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
EFFECTS OF AIRCRAFT RELATIVE DENSITY ON SPIN AND RECOVERY CHARACTERISTICS OF SOME CURRENT CONFIGURATIONS
William D. Grantham and Sue B. Grafton Washington, NASA, Mar. 1965 40 p refs
(NASA-TN-D-2243) CFSTI: HC $2.00/MF $0.50

An analytical study was conducted on a high-speed digital computer utilizing six-degree-of-freedom equations of motion

to examine the effects of relative density on the spin and recovery characteristics of four configurations representative of modern airplanes. The results indicate that the effects of changing relative density on developed spins and recoveries were as follows: An increase in relative density gave faster rotating spins, higher rates of descent, lower values of the spin coefficient, little change in angles of attack and sideslip; recoveries, if obtained, were slower. Changes in relative density can make the difference between a spin and a no-spin when entry is attempted by means of a 1-g stall maneuver, but the effect of relative density is not consistent. About the only generalization that can be made on the effect of relative density on the spin entry is that increases in relative density cause increased roll oscillations during the spin-entry motions. Author

N65-19279*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

A STUDY OF PRESSURE AND HEAT TRANSFER OVER AN 80° SWEEP SLAB DELTA WING IN HYPERSONIC FLOW

Allen H. Whitehead, Jr. and James C. Dunavant Washington, NASA, Mar. 1965 50 p refs

(NASA-TN-D-2708) CFSTI: HC $2.00/MF $0.50

The wing has cylindrical leading edges, a hemispherical nose of the same radius, and a length of 7.12 nose diameters. The angle-of-attack varied from 0° to 35°. Reynolds numbers of 9.9×10^4 and 37.0×10^4 based on model thickness were obtained at Mach 6.8, and a Reynolds number of 10×10^4 was employed for the Mach-9.6 tests. The nose greatly influenced the flow behavior over the leading-edge region at low angles-of-attack. Two results of this apex influence were apparent in the pressure distribution over the leading edge of the 80° swept wing. An empirical swept-cylinder theory greatly overpredicted the pressure level over the leading edge of the 80° swept wing. There was also a characteristic decrease in the pressures down the leading edge of the 80° swept wing in contrast to the nearly constant pressure level in the same region of a lower swept delta wing. The heat-transfer distribution over the leading-edge region of the 80° swept wing was similarly influenced by the nose region geometry. As angle-of-attack increased, the nose influence diminished and the heat-transfer and pressure distributions over the leading edge of the 80° swept wing conformed to the two-dimensional swept-cylinder behavior exhibited by the lower swept wings at all angles-of-attack. Constant-pressure strip theory predicts the heat transfer correctly over the slab portion of the delta wing only for the intermediate angles-of-attack. Author

N65-19547# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.

RECENT RESULTS IN THE STUDY OF PROBLEMS OF MIXING AND REATTACHMENT

Pierre Carriére and Maurice Sirieix [1964] 20 p refs In FRENCH Presented at the 11th Intern. Cong. of Appl. Mechan., Munich, 30 Aug.–5 Sep. 1964

Experiments on conical separation carried out in the almost complete absence of perturbation have confirmed that the Chapman–Korst criterion of turbulent separation must be modified. Work carried out in plane flow and flow of revolution, in the presence of an initially turbulent boundary layer of negligible thickness, leads to the same conclusion. It is not yet possible to exactly construct a criterion of separation encompassing all the results obtained, but an approximate approach is proposed that differs greatly from that of Chapman–Korst.

Trans. by M.P.G.

N65-19872*# University of Southern Calif., Los Angeles. School of Engineering

IMPACT PRESSURE PROBE RESPONSE CHARACTERISTICS IN HIGH SPEED FLOWS WITH TRANSITION KNUDSEN NUMBERS

J. B. Wainwright and K. W. Rogers 16 Nov. 1964 78 p refs (Contract NAS8-11046)

(NASA-CR-57475; USCEC-101-101) CFSTI: HC $3.00/MF $0.75

Response characteristics of the impact probe in the transitional regime between free-molecule and continuum flows were investigated both experimentally and theoretically. Experimental data are presented for Knudsen numbers, based on probe diameter, ranging between 0.05 and 10 and with nominal Mach numbers of 1, 3, 6, and 10. The configurations tested were chosen with the view toward separating internal and external probe geometric effects in the transitional regime. Measurements were made with the probes held at the free-stream total temperature and at 41% of total temperature. The theoretical investigations of probe response were based on a first collision modification of the free-molecule model. Both internal and external effects are calculated and good agreement is shown with the experiments. The free-molecule theory is also extended to the more complicated internal probe geometries which were employed in the experiments. Application of these investigations to flight measurements is outlined. Author

N65-19919*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXPERIMENTALLY DETERMINED PENDULUM ANALOGY OF LIQUID SLOSHING IN SPHERICAL AND OBLATE-SPHEROIDAL TANKS

Irving E. Sumner Washington, NASA, Apr. 1965 26 p refs (NASA-TN-D-2737) CFSTI: HC $1.00/MF $0.50

An experimental investigation was conducted to determine the general liquid-sloshing characteristics (fundamental frequencies, horizontal or side slosh forces, and damping ratios) as well as quantities for a pendulum analogy that would effectively represent the fundamental mode of liquid sloshing in unbaffled oblate-spheroidal and spherical tanks over a range of liquid depths. Tanks having a diameter of 32.0 inches were used. Vertical and horizontal slosh forces were measured to determine several of the pendulum-analogy parameters. These parameters included the pendulum mass, the length of the pendulum arm, the hinge-point location of the pendulum arm, the maximum angles through which the pendulum can oscillate, and the fixed mass. The experimental results are presented in terms of dimensionless parameters that are independent of tank size, imposed longitudinal acceleration, and density and viscosity of the contained liquid. Author

N65-19922*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN EXPERIMENTAL INVESTIGATION OF SUPPORT INTERFERENCE ON A BLUNT BODY OF REVOLUTION AT A MACH NUMBER OF APPROXIMATELY 20

Charles G. Miller, III Washington, NASA, Apr. 1965 29 p refs

(NASA-TN-D-2742) CFSTI: HC $2.00/MF $0.50

An investigation was conducted to determine the effects of support interference on the base pressure of a hemisphere cylinder with a ratio of length to base diameter of 1. With base pressure serving as the indication of support-interference effects, the parameters sting length, sting diameter, and shroud

semiapex angle were examined. The investigation was performed at a free-stream Mach number of approximately 20 over a range of free-stream Reynolds numbers per foot from 3.00×10^5 to 4.65×10^5 at zero angle of attack. With a shroud having a semiapex angle of 30° and diameter of 0.834 model base diameter, the base pressure coefficient was independent of ratios of sting length to model base diameter greater than 2. When a shroud of the same diameter, but having a 90° semiapex angle, was employed, the base pressure coefficient was independent of ratios of sting length to model base diameter greater than 3. For all support parameters investigated, no effect on the model surface pressure immediately ahead of the base was noted. Author

N65-19924*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EQUATIONS FOR ISENTROPIC AND PLANE SHOCK FLOWS OF MIXTURES OF UNDISSOCIATED PLANETARY GASES
Victor L. Peterson Washington, NASA, Apr. 1965 36 p refs (NASA-TR-R-222) CFSTI: HC $2.00/MF $0.50

Equations for aerodynamic quantities of interest in equilibrium isentropic one-dimensional flows and for properties across plane shock waves in arbitrary mixtures of planetary gases are derived under the assumption that the gases obey the perfect gas law. This assumption restricts the range of applicability of the equations to conditions for which the onset of chemical dissociation or ionization has not been reached although no requirement for the gases to be calorically perfect is imposed. Analytic functions used to specify the variation of specific heats with temperature are consistent with the assumption that molecular vibrations behave like harmonic oscillators and are independent of rotational degrees of freedom. It is shown that while some of the flow quantities characterizing aerodynamic flows are very sensitive to gas composition, the stagnation pressure coefficients for a number of gases differ by only a few percent from one gas to another. Author

N65-19996# Vehicle Research Corp., Pasadena, Calif.
AERODYNAMIC CHARACTERISTICS OF JET-FLAPPED AIRFOILS IN GROUND EFFECT
Peter B. S. Lissaman 31 Dec. 1964 90 p refs
(Contract Nonr-4566(00))
(VRC-18; AD-610535)

The basic flow equations are derived, and it is shown that the field equation is linear but the boundary conditions are not. This difficulty is removed by linearization. By a conformal mapping and by applying the appropriate kinematic and dynamic boundary conditions, an integrodifferential equation with singular kernels in the transform plane is derived. The singularities of the equation are identified and discussed. The singularities are 'removed' by the addition of functions exactly satisfying the integrodifferential equation at the singular points. The remaining terms can be approximated and evaluated by a collocation process involving two Fourier series. A matrix, whose inverse defines these series, is developed, its elements being generated in a form suitable to digital-computer techniques. Further areas of associated research are proposed, including extensions to nonlinear effects, unsteady cases, turbulent jet flows, wind tunnel corrections, and finite wings in ground effect. Author

N65-19999# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
A WIND-TUNNEL INVESTIGATION OF SOME SHORT-CHORD LOW-SOLIDITY SHROUDED PROPELLERS IN THE CRUISE CONDITION
William B. Maguire Nov. 1964 31 p refs
(DTMB-1919; AD-612184)

Cruise performance of two powered shrouded propeller configurations with nominal length-to-diameter ratios of 0.1 and 0.2, each with a two- and a three-bladed propeller is presented. Performance data in pitch were obtained at thrust coefficients as low as 0.07. Possible use of shrouds as lifting surfaces during transition or cruise is another performance area treated. Author

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N65-18775# Boeing Co., Seattle, Wash.
TOMORROW'S AIR TRANSPORTATION
William M. Allen [1965] 12 p Presented at the Meeting of the Natl. Defense Transport. Assoc., Washington, 27 Jan. 1965

The status of the supersonic transport (SST) and the significance of a large military logistics transport (C-5A) development to satisfy a clear military need are discussed. The C-5A airplane could carry, over intercontinental ranges, all the heavy equipment, supplies, and personnel of an Army division and, in terms of future commercial application, could carry a 120-ton cargo or as many as 700 economy passengers. The SST and C-5A developments are regarded as complementary. The SST development has reached a stage where not much further gain is expected by wind tunnel studies or paper analysis; now the need for prototypes is expressed for gaining the remaining information required before going into a production program. G.G.

N65-18878# Ling-Temco-Vought, Inc., Dallas, Tex. LTV Vought Aeronautics Div.
FEASIBILITY STUDY, XC-142A MODIFIED FOR OPEN OCEAN OPERATION
K. R. Marsk 9 Feb. 1965 190 p refs
(Contract NOw-64-0500-f)
(V-464)

A study was performed to determine the feasibility of developing a seaplane version of the Model XC-142A airplane. A STOL seaplane version and a VTOL seaplane version of the Model XC-142A airplane, both fitted with inflatable vertical floats, were studied, and the feasibility of developing both of these airplanes was established. As a result of this feasibility study, it is recommended that further engineering work be done to establish the validity of the assumptions used. Author

N65-18892# Air Force Inst. of Tech., Wright-Patterson AFB, Ohio. School of Systems and Logistics
A STUDY OF THE MEASUREMENT OF FAILURE RATES OF CERTAIN AIRCRAFT COMPONENTS
James O. Turner (M.S. Thesis) Aug. 1964 119 p refs
(SLSR-20-64; AD-451374)

Improvement of the measurement of failure rates, and the evaluation of measurement methods in use for aircraft components are reviewed. The thesis is restricted to the study of failure rates of autopilot components in operational use, and to the use of those rates for computing followon requirements. Collection of data, analysis, conclusions, and recommendations are covered. E.E.B.

N65-18989# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DESIGN AND ECONOMICS OF AIRCRAFT
D. L. Tomashevich 15 Dec. 1964 257 p refs Transl. into ENGLISH of the book "Konstruktsiya i Ekonomika Samaleta" Moscow, Gos. Nauchn.-Tekn. Izd. Oborongiz, 1960 p 1–202
(FTD-MT-64-102; AD-609913)

Presented are theoretical considerations and engineering formulas for design appraisal of aircraft from the standpoint of economics. Methods and solutions pertaining to questions on the selection of material, design of details and parts of aircraft, dimensions of the main parts, and of a power plant, means of increasing exploitational reliability, expedient ways to increase flying characteristics of aircraft, and selection of the most suitable aircraft for execution of a definite assignment, etc., are considered. G.G.

N65-19083# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBABILITY OF AIRCRAFT BUMPINESS AT VARIOUS WIND VELOCITIES
M. V. Zavarina 1 Feb. 1965 13 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 149, 1963 p 29–34
(FTD-TT-64-811/1; AD-611014)

The relationship between the probability of aircraft bumpiness and the wind velocity in and above clouds is discussed. It was observed that the bumpiness probability increases in the upper part of the troposphere with an increase in wind velocity. A rise in the bumpiness probability with an increase in wind velocity was observed in the lower atmospheric layer only when flying in clouds. It is concluded that the maximum rise in the probability of bumping is caused by the presence of clouds in the atmosphere and not by a rise in wind velocity. D.E.W.

N65-19201# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VERTICAL TAKE-OFF AIRCRAFT
1 Mar. 1965 6 p Transl. into ENGLISH from Obrance Vlasti (Czech.), v. 12, 19 May 1964 p 1–4
(FTD-TT-64-988/1; AD-458247)

Propeller driven and jet propelled craft using tilting and folding wing concepts are discussed. Operational problems cited are overload instability during takeoff, and poor stability and handling qualities in transitional and landing phases. E.P.V.

N65-19605# College of Aeronautics, Cranfield (England). Dept. of Electrical and Control Engineering
PROPOSALS FOR A BASIC THEORY OF AIR TRAFFIC CONTROL
R. N. Lord Jul. 1964 11 p
(COA-NOTE-E&C-2)

The basic principles of Air Traffic Control (ATC) are examined, and a mathematical basis for an analysis of the current and future ATC complex is discussed. The theory is based upon feedback control concepts using intermittent data. Examples showing the application to en route airway and parallel track flying are given. These demonstrate the effect of positional data updating rate upon separation minima for both subsonic and supersonic aircraft. Author

N65-19802# Boeing Co., Renton, Wash. Airplane Div.
THEORETICAL DETERMINATION OF CRASH LOADS FOR A LOCKHEED 1649 AIRCRAFT IN A CRASH TEST PROGRAM
James P. Bigham, Jr. and William W. Bingham Jul. 1964 63 p refs
(Contract FA-64WA-5021)
(ADS-15)

Acceleration time histories in directions normal and parallel to the fuselage cabin floor are given at 3 positions along the length of the fuselage for impact velocities of 140, 160, 180, and 200 feet per second. It is concluded that during the initial impact at 180 feet per second, peak normal accelerations of 11, 0, and −3 times that of gravity (G's) will be developed 0.03 seconds after impact at body stations 180, 682, and 1176. Maximum normal and longitudinal accelerations during the 6° ramp crash will occur at 0.24 seconds. Maximum normal accelerations at body stations 180, 682, and 1176 will be −17, 8, and 35 G's, respectively. Maximum longitudinal accelerations will be 4 G's. It is further concluded that the nose of the airplane will bend upward 10 inches relative to the center section of the fuselage 0.14 seconds after impact. If the fuselage should fail, all analytical results beyond the time of failure will be questionable to a degree dependent on the type of failure that occurs. Author

N65-19807# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service
EVALUATION OF IN-FLIGHT APPLIED WINDSHIELD RAIN REPELLENTS
Paul M. Rich and Charles R. Grisel Dec. 1964 37 p
(FAA-ADS-32)

Rain repellents that can be applied in flight were evaluated to determine their effectiveness in improving windshield visibility during precipitation. Comparative 16 mm motion pictures were obtained of the pilot's and copilot's windshields during approaches to landing in precipitation. Laboratory tests were conducted to determine the effects of these repellents on glass and aluminum over a prolonged period and also to determine the repellents' freezing points. Author

N65-19812# International Civil Aviation Organization, Montreal (Quebec).
AIRCRAFT ACCIDENT DIGEST NO. 13
1964 361 p refs
(ICAO-Circ.-69-AN/61)

Summaries of aircraft accident reports, comments on these summaries, classification tables, and causes are contained in this digest. Aircraft accident statistics and a listing of laws and regulations of contracting states containing provisions relating to investigations are presented. Reprints of *And Then... There is Down, SCUBA Hazard to Aircrews*, and *Wrong Indication of Captain's and Co-pilot's Pressure Instruments* are also included. E.E.B.

N65-20069# Toronto Univ. (Ontario). Inst. for Aerospace Studies
ON THE LATERAL INSTABILITIES OF AIRCRAFT DUE TO PARAMETRIC EXCITATION
M. Masak Jan. 1965 73 p refs
(Grant AF-AFOSR-222-63)
(UTIAS-TN-86; AD-457979)

Lateral instabilities of aircraft due to parametric excitation are studied. A theoretical discussion involving asymptotic approximations to the state transition matrix and a Liapunov stability analysis are presented first. This is followed by an analog computer study to observe the actual phenomenon. Both high-aspect-ratio swept-wing and slender delta-wing jet transports are considered. Author

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N65-18682# Naval Ordnance Lab., Corona, Calif. Research Dept.

CHEMOELECTRIC ENERGY CONVERSION FOR NON-AQUEOUS RESERVE BATTERY SYSTEMS Quarterly Report, Oct.–Dec. 1964

15 Jan. 1965 36 p refs

(NAVWEPS-8229; AD-610708)

A new cell fixture was placed in service to measure conductivities of liquid ammonia and solutions of salts in liquid ammonia. The cell fixture was used in different configurations for initial studies of voltaic cells having a pill-type construction; the conductivities of cell pills were also determined. Modification of the cell-fixture construction was accomplished to permit voltametric studies in this environment. It was found that $(NH_4)_2SO_4$ is unsuitable as an insoluble acid catholyte when using *m*-dinitrobenzene as the active cathode material. It is believed that the rate of solution of the acid is too slow and that this is the cause of poor performance at high current density. The study of cation effect showed that the zinc ion has a serious detrimental effect on cathode performance even when excess acid is present in the cell. For cells tested in the research single-cell test fixture, the thickness of the electrolyte pad was reduced to 1/3 mm without apparent degradation. A number of positive halogen compounds screened for use as cathodes in the ammonia system reacted violently with ammonia gas and with electrolyte solutions. Two of the eight compounds show slight promise. Studies are in process on various problems concerning the design and analysis of experiments, including measurement and experimental-error analysis, statistical methods, and data processing and evaluation. An example is tabulated showing the influence of small differences in test conditions upon components of experimental error.

Author

N65-18771 Joint Publications Research Service, Washington, D. C.

ON OPTIMAL CONTROL OF THE PROCESS OF MONOCRYSTAL PULLING FROM A MELT

S. A. Malyy *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 237–245 (See N65-18751 09-34) CFSTI: $6.00

The process of crystal pulling from a melt is investigated. Three problems are posed for optimal control of the process which may be solved on the basis of the theory of optimal control of objects with distributed parameters.

Author

N65-18832* National Aeronautics and Space Administration, Washington, D. C.

ACCELEROMETER AND ITS MEASURED RESULTS

Iwaho Yoshiyami, Ensei Nakamura, and Motoyoshi Hayashi *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 233–240 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

An accelerometer design is described for various Kappa rockets used in the Japanese space program. Acceleration and velocity curves for flight of a two-stage rocket are shown. J.M.D.

N65-18833* National Aeronautics and Space Administration, Washington, D. C.

THERMOMETER, STRAIN GAUGE AND TRANSVERSE ACCELEROMETER

Sigeo Imazawa and Takemi Wanami *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 241–246 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Temperature- and stress-measuring devices for installation on space rockets are reevaluated. They are: (1) Thermometer—Using a new temperature measuring device, a thermoelectric sensor as the detecting element and a transistor chopper-type dc amplifier were tested in flight. (2) Strain gage—The stress on the tails of the K-8L- and 9M-type space rockets was measured with a conventional strain gage, indicating that aerodynamic heat increased with improvement of rocket performance, and the heat increased rapidly during the end of combustion. (3) Transverse accelerometer—Accelerometer Y_1 was used to measure the acceleration of a rocket. The acceleration was very small and a 1-g shock, due to the opening of the nose cone, was the maximum value.

R.W.H.

N65-18834* National Aeronautics and Space Administration, Washington, D. C.

TIMER

Iwaho Yoshiyama, Hroshi Sakai, and Hakui Kumatorilani *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 247–249 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The timer has a floating cam-type micromotor (CL-28-1 type, 6 V of rated voltage, and 18-mA driving current) and a microswitch. The timer functions as follows. One end of a piano wire is fastened to the launcher and the other end is fixed to the start switch of the timer. When the rocket is launched, the piano wire slips off the start switch, the switch is turned on, and the micromotor begins to rotate. Later, the motor axle gears hook into the cam plate. The cam plate is rotated by the motor, turning on the microswitch, and the ignition circuit is connected. Then the nosecone-opener actuator functions. A signal, sent to the teletransmitter when the circuit is completed, assures connection of the circuit.

R.W.H.

N65-18836* National Aeronautics and Space Administration, Washington, D. C.

COLORIMETER

Iwaho Yoshiyama, Akio Hirozawa, and Susumu Matsusima *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 254–256 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

A rocketborne colorimeter was developed. In connection with the timer, the colorimeter was used to detect the booster cutoff, main rocket engine ignition, and abnormal combustion of the engine. The colorimeter was used at the ground combustion test of the L-735 3/3 rocket engine as a preliminary procedure and satisfactory results were obtained.

R.W.H.

N65-18871# Westinghouse Electric Corp., Pittsburgh, Pa. Westinghouse Research Labs.

CEROLYTE FUEL CELL Quarterly Technical Progress Report

D. H. Archer, E. F. Sverdrup, L. Elikan, and W. A. English 10 Dec. 1964 51 p refs

(Contract AF 33(615)-1425)

(QTPR-3; AD-608973)

The operating characteristics of a 50-watt hydrogen–oxygen fuel-cell power generator for aerospace application are reviewed. Advances in the production of wetted electrode films are reported. Two of the fused electrode specimens produced using the zirconium hydride "getter" showed less than 20 millivolts of polarization at a current density of 360 ma/cm^2 in oxygen atmospheres, and over 170 mV of polarization at this current density in hydrogen atmospheres. The high polarization in fuel atmospheres displayed characteristically long relaxation times of over 100 milliseconds. The objectives of a test program for evaluation of the fuel cells is included. The effect of electrode weights and sintering conditions on cell performance, and the design and fabrication progress are reported. E.E.B.

N65-18920*# Allis-Chalmers Mfg. Co., Milwaukee, Wis. Research Div.

RESEARCH AND DEVELOPMENT ON FUEL CELL SYSTEMS Second Quarterly Progress Report, 1 Oct.–31 Dec. 1964

J. L. Platner 26 Feb. 1965 73 p
(Contract NAS8-2696)
(NASA-CR-57154; NAS8-2696-QPR-00002) CFSTI: HC $3.00/MF $0.75

The following work was performed in three major test areas. *Research and Technology*—(1) Tests determined that 15 cc of KOH is the minimum required for a centerline designed fuel cell. (2) Preselection of asbestos membranes for uniform density increased uniform performance between cells. (3) A computer program for thermal analysis of fuel cell systems was evolved. (4) Computer analysis showed the stability of the regulating controller. *Breadboard and Experimental Items*—A modified 29-V, 1.8-kW breadboard system was successfully operated under load. *System Test Models*—(1) Fuel cell system models using advanced fuel cell technology were built. (2) Performance test results of the breadboard systems were incorporated into the centerline design models. G.G.

N65-18934*# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.

DEVELOPMENT OF IMPROVED SINGLE CRYSTAL GALLIUM PHOSPHIDE SOLAR CELLS Final Report, Jun. 12, 1963–Aug. 12, 1964

W. O. Groves and A. S. Epstein [1964] 162 p refs
(Contract NAS3-2776)
(NASA-CR-54273) CFSTI: HC $5.00/MF $1.00

In order to develop an efficient solar cell operable at temperatures up to 500°C, single crystal gallium phosphide was grown by epitaxial deposition from the vapor phase on gallium arsenide substrate. The gallium arsenide was then removed. The gallium phosphide produced was highly compensated. Electrical properties and analysis indicated impurity levels in the range of 5×10^{18} atoms/cm^3, whereas net carrier levels in the low 10^{18} cm^{-3} range are typical for undoped < 100 > oriented material. Typical mobilities of 100 cm^2/volt cm were measured. The major impurity was silicon, originating in the phosphorus source or from reaction of the gases with silica at high temperature. Diffused junction cells were fabricated, and the photovoltaic properties of the cells were measured up to high temperatures. The design and performance of the cells were related to the electrical and optical properties of the gallium phosphide. Limitation on the solar cell appears to be the series resistance of the junction which should be improved by purer material. R.L.K.

N65-18977# Rensselaer Polytechnic Inst., Troy, N. Y.

INVESTIGATION OF THE FUNDAMENTAL ELECTROCHEMICAL PARAMETERS INFLUENCING FUEL CELL PERFORMANCE Final Report

N. D. Greene 15 Sep. 1964 7 p refs
(Contract AF 19(604)-8377)
(AFCRL-64-793; AD-609718)

Several aspects of electrochemical energy conversion were investigated. A theoretical analysis of electrochemical energy conversion devices was developed and checked by experimental measurements. The results show that performance characteristics of a cell can be predicted from the polarization curves of the individual electrodes. The design and performance of a precise and versatile automatic polarization apparatus are described. This device records polarization results directly on semilogarithmic paper. High-current palladium–hydrogen diffusion electrodes can be achieved by oxidation pretreatment. An equation for hydrogen diffusion in β-palladium has been determined. Author

N65-18996# AiResearch Mfg. Co., Phoenix, Ariz.

CLOSED-BRAYTON-CYCLE SOLAR-POWER-UNIT RESEARCH AND DEVELOPMENT PROGRAM Technical Documentary Report, May 1963–May 1964

A. Pietsch Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 440 p refs
(Contract AF 33(657)-11721)
(APL-TDR-64-103; AD-610043)

Problem areas considered critical to the use of a closed Brayton cycle for a solar-powered space power system were reviewed and experimental investigations were conducted to define potential problems. Analyses and experimental testing were conducted to verify that small radial compressors can be made to operate successfully on monatomic gas. The feasibility of using hydrostatic, porous-shoe, flexibly mounted gas bearings was evaluated by testing on a single-shoe and a dynamic two-bearing test rig. The radiator development effort included (1) testing on a single-tube test rig to determine the friction and heat-transfer characteristics of internally finned tubes, (2) manifold distribution and pressure-drop tests to ascertain the amount and effect of nonuniformity in flow, and (3) testing of a radiator panel under vacuum conditions to determine the heat-rejection capability of tube–fin radiator sections. Two radiator sections were deployed under simulated space conditions to show that a low-redundancy, efficient deployment mechanism can be designed and utilized. A lithium fluoride hot-fill technique was used to fill a concentric finned tube cavity, which was then used for tests to determine the heat-transfer characteristics of the heat receiver–storage unit. D.S.G.

N65-19162# Army Electronics Labs., Fort Monmouth, N. J. Electron Tubes Div.

INSTANTANEOUS ELECTROLUMINESCENT CELL RESPONSE TO PULSE EXCITATION

Isidore H. Stein Nov. 1964 24 p refs
(ECOM-2523; AD-610484)

Previous electroluminescent cell pulse-response data were collected using equilibrium values for a constant repetition rate pulse train. The present investigation concerns the response of E1 cells to individual rectangular pulses. Measurements of light output were made on each successive pulse, starting with the first pulse, until the equilibrium values were reached. The variation of this response with changes in pulse excitation rise and fall times was explored, and the double light output peak occurrence caused by selected rectangular pulses was observed and measured for peak level and rate of

decay. The visibility of the light output for initial and successive pulses was evaluated under constant ambient conditions. The above aspects of electroluminescent response were correlated for severe E1 cell designs with dissimilar phosphors, widely different cell thicknesses, and binder matrix materials of plastic or soft glass. Author

N65-19165# Army Electronics Labs., Fort Monmouth, N. J. Power Sources Div.
STANDARD LINE ALKALINE SECONDARY BATTERIES
E. J. Settembre Jul. 1964 25 p
(ECOM-2527; AD-610010)

The development of a family of secondary batteries based on the design of only 18 sizes of battery boxes will make available for field use 108 units to provide 6-, 12- and 24-V operation in capacities from 3.5 to 220 A-h. These 108 units will be built in three electrochemical systems (the nickel–cadmium, the zinc–silver oxide, and the cadmium–silver oxide) and will be made up of vented or sealed cells standardized previously. The flexibility and interchangeability to be derived from such a family of batteries will be enhanced further by incorporating in the design capability for operation of one-third of these batteries at 24 or 12 V and one-third at 12 or 6 V. The cases will be designed of fiberglas-reinforced plastic to withstand severe environmental conditions and to provide operation with or without covers. With the covers removed, coupling directly to using equipment will be possible. Author

N65-19185# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A CONTRIBUTION TO THE EVALUATION OF MEASUREMENTS OF COMPRESSOR-BLADE CASCADES AT HIGH SUBSONIC VELOCITIES
Otakar Novak 13 Jun. 1963 23 p refs Transl. into ENGLISH from Strojnicky Casopis (Prague), no. 3, 1962 p 273–288
(FTD-TT-63-166/1+2; AD-409304)

The determination of energy losses originating when a flow of viscous fluid is directed around the surfaces of blade grids, i.e., losses due to friction in the boundary layer, flow mixing, separation of boundary layer from the blade surface, and passing shock waves, is discussed. A method for estimation of the results in traversing a wake behind the level of a compressor blade grid at high subsonic velocities is presented.
E.E.B.

N65-19265*# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
RESISTOJET RESEARCH AND DEVELOPMENT, PHASE II Second Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Richard R. John and Dean Morgan 20 Jan. 1965 121 p refs
(Contract NAS3-5908)
(NASA-CR-54333; AVCO-RAD-SR-65-44) CFSTI: HC $4.00/MF $1.00

Experimental results are presented on the transient propulsion performance of a 10-watt fast heatup resistojet which operates in the thrust range of from 100 to 500 micropounds. The resistojet consists of a thin-wall tubular heating element with a 5-mil throat diameter exit nozzle. Engine performance data were obtained with a direct force measurement thrust stand. A single axis resistojet attitude control system is described. The resistojet ACS contains an ammonia propellant feed system, control logic and power conditioning test packages, a position sensor, and three nominal 10-watt resistojet engines. Two of the engines are for attitude control, and one of the engines is for station keeping. Author

N65-19421# Gulton Industries, Inc., Metuchen, N. J. Alkaline Battery Div.
INVESTIGATION OF HERMETICALLY SEALED MAINTENANCE-FREE, HIGH RATE, NICKEL-CADMIUM BATTERIES FOR AIRCRAFT APPLICATIONS
E. Kantner, H. N. Seiger, and R. C. Shair Feb. 1965 46 p
(Contract AF 33(615)-2087)
(AD-611404)

An MS 24498 battery was subjected to constant potential charging at 26, 28, 30, and 32 V to determine the charging current at these voltages. Following charging, the cells were discharged to 1 V/cell to determine if the battery can be charged to 70% of its rated capacity in 5 minutes between these voltage limits. These data were also used to calculate charge efficiencies. A theoretical analysis outlining the factors which contribute to polarization was made. Sealed nickel-cadmium cells containing plates of varying thickness were tested to determine the effect of current density on voltage behavior during high rates of charge and discharge. High purity nickel and cadmium salt solutions were used to impregnate plates to study the effect of impurities on self-discharge of sealed nickel–cadmium cells. Two different circuit configurations were tested to obtain data for the design of the input stage of the charge control circuit. Author

N65-19434# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
THE DEVELOPMENT OF A LOW-TEMPERATURE CYLINDRICAL THERMIONIC GENERATOR Quarterly Report, 16 Sep.–15 Dec. 1964
W. B. Hall Dec. 1964 49 p
(Contract AF 33(615)-1547)
(QTR-3; AD-609966)

Evaluation and analysis of insulated converters established their reliability, long-life design, and the insulation effectiveness of the cast alumina layer. Four improved modules were fabricated, and their reliability was demonstrated by 240 hours of operating time. The radiation heat rejection system for the last module serial was redesigned to provide additional collector cooling. The gas dosing injection system was modified to provide more accurate gas injection. Collectors of cesium fluoride, cesium sulfate, tungsten trioxide, irridium matrix, and palladium matrix were tested in converters in the low-work-function collector investigation, and the results were unsatisfactory. Compiled and analyzed data on both molybdenum and niobium high-temperature collectors showed that they can be operated as high as 700° C at an emitter temperature of 1350° C, without inordinate loss of power. G.G.

N65-19458# Pratt and Whitney Aircraft, East Hartford, Conn.
LIQUID HYDROCARBON FUEL CELL DEVELOPMENT Final Technical Report, 27 Jul. 1964–27 Jan. 1965
H. H. Heilbronner, J. W. Allison, and W. P. Levins [1965] 73 p
(Contract DA-44-009-AMC-758(T))
(PWA-2549)

This is a report on a compound anode, hydrocarbon–air fuel cell. The objective of this study was to prove the feasibility of operating a compound anode fuel cell on a liquid hydrocarbon and to define the important parameters that influence cell performance. Both reformer and fuel cell tests were conducted with various liquid hydrocarbon fuels. Included in this report is a description of the compound anode and test facilities used. The profound effect of hydrogen extraction on the equilibrium of the reform reaction and the feasibility of operating a fuel cell of this type is demonstrated. The effects of the fuel, catalyst bed depth, catalyst particle size and baffling on the cell performance are discussed. Author

N65-19487# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROGRAM ROE (REFLECTOR ORBITAL EXPERIMENT). PART I: PRELIMINARY DESIGN—FLIGHT TEST SYSTEM Technical Report, 1 Jul.–4 Oct. 1963
Dec. 1964 250 p refs
(Contract AF 33(657)-10668)
(LMSC-A704576; AFAPL-TR-64-132, Pt. I; AD-612014)

This work lay largely in three areas: (1) a systems engineering preliminary design study, (2) component and vehicle integration studies, and (3) fabrication and test of selected components. Data obtained from scaled versions of solar reflectors is not pertinent to development of full-scale reflectors. Major attention should be directed to the structural integrity of large thin-walled or thin-sectioned space structures. Before development of solar reflectors, with confidence, present reflector analytical techniques must be modified, or new ones evolved. The calorimeter–radiometer instrumentation used at the focal zone for flight-test-data purposes requires an intensive development program. The foamed and rigidized-in-space reflector concept requires the selection of suitable orbits, to assure that the foaming mechanics will take place in an environment of stable temperature flux during the ridigizing process. Author

N65-19488# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROGRAM ROE (REFLECTOR ORBITAL EXPERIMENT). PART II: PRELIMINARY DESIGN—UNFURLABLE METAL PETAL SOLAR REFLECTOR CONCEPT
Dec. 1964 146 p refs
(Contract AF 33(657)-10668)
(LMSC-A668845; AFAPL-TR-64-132, Pt. II; AD-612015)

A preliminary design study was conducted on the implementation of an all-metal solar reflector for an orbiting satellite experiment. The study included system and component preliminary design, certain aspects of vehicle integration design, ground feasibility testing, and the fabrication of critical or unproven components. A limited program for developing techniques for the fabrication of large (40- to 60-foot diameter), unfurlable, solar-dynamic reflectors, comprised of electroformed, monocoque, nickel petals is described. Critical techniques were created or developed for (1) applying plastic overlays; (2) fabricating petals and backing mandrels; (3) parting petals; and (4) applying reflective and protective coatings. The resulting reflectivity, geometrical accuracy, and specific weights were tested and correlated with four different petal designs, fabricated by the various improved techniques. Author

N65-19489# Lockheed Missiles and Space Co., Sunnyvale, Calif.
PROGRAM ROE (REFLECTOR ORBITAL EXPERIMENT). PART III: PRELIMINARY DESIGN: INFLATABLE RIGIDIZED SOLAR REFLECTOR CONCEPT, VOLUME II: PARAMETRIC DESIGN STUDY OF INFLATABLE SOLAR REFLECTOR THERMAL DEFLECTIONS
Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 268 p refs
(Contract AF 33(657)-10668)
(LMSC-A702684; AFAPL-TR-64-132, Pt. III, Vol. II; AD-612016)

A computer program was developed for analysis of contour deviations as a function of the thermal environment and the physical properties of materials used in solar concentrators of an inflatable rigidizable construction. The program was applied to a study of the effects of changing various design parameters such as surface thermal properties, core density and concentrator dimensions. The detail effort consisted of establishing a digital computer program suitable for the IBM Model 7094 in Fortran II Language. Instructions for use of this program are also presented. Author

N65-19491# Harry Diamond Labs., Washington, D. C.
A PROCEDURE FOR DEVELOPMENTAL DROP-TESTING SAFETY AND ARMING MECHANISMS CONTAINING TIME-INTEGRATION SYSTEMS
Arthur Hausner 25 Jun. 1964 25 p refs Previously issued as HDL Report R-320-61-4
(HDL-TR-1239; HDL-R-320-61-4; AD-604102)

The general ordnance developmental drop-test program is discussed with an aim toward establishing a procedure for drop-testing time-integration systems in safety and arming mechanisms. An attempt is made to justify use of impact media that give rise to approximately constant acceleration-time characteristics as being the most practical means of insuring safety for a given drop height and, at the same time, of providing the most reliable index of safety that can be experimentally determined. An example of how the procedure is used is also described. Author

N65-19495# General Instrument Corp., Newark, N. J. Thermoelectric Div.
SOLAR FLAT PLATE THERMOELECTRIC GENERATOR RESEARCH
Robert E. Rush Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., 14 Sep. 1964 74 p refs
(Contract AF 33(657)-10335)
(APL-TDR-64-87; AD-605931)

The collector and radiator plates were folded into self-supporting structures which, combined with aluminum tubular members, comprised the panel support configuration. This design resulted in a very low converter weight, only 53 grams per square foot. A number of prototype panels, both 4 in. × 4 in. and 12 in. × 12 in. in area were tested. These tests included sinusoidal vibration, 14–3000 cps, to 15 g's for 45 minutes in each axis; random vibration, white noise with an amplitude of 0.05 g^2 for 5 minutes in each axis; acceleration, 12 g's in each axis for 10 minutes; and 3 shocks of 40 g's for 6 milliseconds in each axis. The panels were also subjected to 500 thermal cycles of 1 1/2 hour per cycle. Other panels were subjected to over 6000 thermal cycles without resistance change. The overall panel performance in the earth orbit operational temperature regime resulted in approximately 11 watts per pound of panel. Author

N65-19504*# Livingston Electronic Corp., Montgomeryville, Pa.

DEVELOPMENT OF HIGH ENERGY DENSITY PRIMARY BATTERIES 200 WATT HOURS PER POUND TOTAL BATTERY WEIGHT MINIMUM Quarterly Report No. 2, 10 Sep.–9 Dec. 1964

Sanders G. Abens [1964] 84 p refs

(Contract NAS3-6004)

(NASA-CR-54307) CFSTI: HC $3.00/MF $0.75

Conductivity of $LiClO_4$ solutions was observed to be consistently higher than that of $AlCl_3$ solutions in the organic solvents studied. In dimethyl sulfoxide, lithium chloride produced strongly conductive solutions of 5×10^{-3} mho/cm at 75 g/liter. Lithium fluoride was found to be soluble in nitromethane and in n-butyl formate to the extent of 5.0 g/liter and 6.5 g/liter, respectively. Specific conductances of the resultant solutions did not, however, vary significantly from those of the pure solvents. Propylene carbonate, dimethyl sulfoxide, butyrolactone, and acetic anhydride were compared in cell discharge tests using lithium–perchlorate as the solute in lithium–cupric fluoride and lithium–manganese dioxide cells. The capacity of acetic anhydride was found to be markedly inferior to the others tested because of electrolyte attack on the lithium electrode. In view of the high conductivity and good cathode efficiency achieved with lithium–perchlorate, methyl formate continues to be of prime interest as an electrolyte solvent though there is a moderate rate of chemical attack on the lithium anode. E.E.B.

N65-19687*# Electro-Optical Systems, Inc., Pasadena, Calif.

DEVELOPMENT OF AN IMPROVED RADIATION RESISTANT SOLAR CELL Final Report, 27 Sep. 1963–27 Dec. 1964

G. P. Rolik [1964] 81 p refs

(Contract NAS5-3560)

(NASA-CR-57287; EOS-4370-Final) CFSTI: HC $3.00/MF $0.75

The results of a program to develop an improved radiation-resistant solar cell by the incorporation of an electric field are described. Included are the results of a theoretical computer evaluation, drift field fabrication experiments, and radiation damage data. A significant correlation was observed between the theoretical considerations and experimental results, which showed that the optimum drift field thickness lies between 50 and 100 microns. Author

N65-19690*# Electro-Optical Systems, Inc., Pasadena, Calif.

HYDROGEN-OXYGEN ELECTROLYTIC REGENERATIVE FUEL CELLS Progress Report, Oct. 5–Nov. 6, 1964

M. Klein 10 Nov. 1964 25 p

(Contract NAS3-2781)

(NASA-CR-57294; EOS-4110-ML-13) CFSTI: HC $1.00/MF $0.50

A number of single cell tests were conducted and the 6-cell 75-watt module was assembled and tested. The 75-watt unit was continually cycled for a 48-hour period, during which its performance was very satisfactory. After the continuous cycling period, additional tests were conducted on the unit to determine the effect of various parameters on performance characteristics. Data from these tests are presented. D.E.W.

N65-19754*# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.

STUDY OF USE OF AUXILIARY ELECTRODES IN SILVER CELLS Quarterly Report No. 3, 1 Aug.–1 Nov. 1964

[1964] 21 p

(Contract NAS5-3669)

(NASA-CR-57262) CFSTI: HC $1.00/MF $0.50

Continued testing of several types of auxiliary electrodes for their use in primary and secondary silver–zinc cells and silver–cadmium cells showed that silver–cadmium cells in continuous overcharge produced a small initial rise in pressure, followed by a decrease to an equilibrium value. A new group of silver–cadmium cells containing auxiliary electrodes were placed on cycling tests. The use of waterproofed, silver-powder auxiliary electrodes for oxygen recombination in silver–zinc cells was found feasible at lower current densities than for silver–platinum electrodes. Studies showed that a silver spinel auxiliary electrode, connected through a diode to the zinc electrode, will pass current only in the presence of oxygen. Test runs on auxiliary electrodes for hydrogen recombination were inconclusive. Seven hydrogen combination cells with a cupric oxide cathode, and either a conventional diffusion type platinum electrode or a solid palladium–silver alloy foil electrode were tested, and a higher current capability for the gas diffusion electrode was observed. G.G.

N65-19755*# Exotech, Inc., Alexandria, Va.

HANDBOOK ON SPACE RADIATION EFFECTS TO SOLAR CELL POWER SYSTEMS

William C. Cooley, Robert J. Janda and Kandiah Shivanandan 22 Jul. 1963 117 p refs

(Contract NASw-598)

(NASA-CR-57267) CFSTI: HC $4.00/MF $0.75

A summary of analytical methods and test data which can be applied in designing radiation-resistant silicon solar cell power systems for earth satellites operating within the 400 to 40 000-mile altitude range is presented. Consideration was given to the electron and proton fluxes and their energy spectra along the proposed orbit, the type of solar cells, the material and thickness of shielding material, the solar cell operating voltage, and the expected operating temperature range. Appendixes contain summarized data on radiation darkening of solar cell cover-slide materials, and radiation effects on transistors and diodes. G.G.

N65-19772*# Sperry Utah Co., Salt Lake City, Utah.

FLUID AMPLIFIER DYNAMIC CHARACTERISTICS, VOLUME II Final Report, Jun. 20–Dec. 30, 1964

F. R. Goldschmied, H. L. Fox, and D. L. Letham 30 Dec. 1964 211 p refs

(Contract NAS8-11236)

(NASA-CR-57349) CFSTI: HC $6.00/MF $1.50

Those aspects of dimensional analysis and similarity of most pertinence to fluid circuitry are discussed. The equations of fluid flow through both orifices and circular tubes are given and discussed. The equivalent parameters of passive fluid elements are presented, both steady state and small signal. The instrumentation of fluids is discussed both for steady-state and time-dependent measurements. Typical active devices are described, discussed, and compared. Specific attention is given to the impact modulator and its use in operational amplifiers. An equivalent circuit for the impact modulator is found. The subject of circuit synthesis, and particularly transfer function synthesis, is discussed. The requirements of proportional fluid circuitry are discussed, and the use of equivalent circuits in the analysis of fluid circuits is presented through the discussion of specific circuits. Both steady-state and time varying examples are given. The loop transfer function of an idealized, but typical, fluid control circuit is presented and analyzed by the use of a Bode plot. Author

N65-19780* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion

EMITTER SURFACE PHYSICS OF PLASMA DIODES

Leon W. Zelby, George L. Schrenk, and M. Kaplit *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965 7 p refs (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The problem of prediction of the surface charge as a function of the crystallographic structure of the substrate, the number of adsorbed particles, and the fraction of charge associated with the ionic and covalent bonding between the adsorbed particles and the substrate is discussed. In order to explicitly include the effects of coverage and substrate structure, a three-dimensional solution was considered necessary. Of the methods available, the statistical theory appeared to be the only one for which a three-dimensional solution was analytically feasible. This method is outlined and equations for the total kinetic energy in terms of particle density, the electrostatic energy of the electron gas, and the two quantum mechanical potential energy terms are included. E.E.B.

N65-19781* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion

EMITTER SHEATH POLARITY IN PLASMA DIODES

George L. Schrenk *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965 13 p refs (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The general criteria used to determine the polarity of the emitter sheath in a plasma diode were examined in detail. Also, a phenomenological macroscopic model was used to determine the correct criteria when interactions exist in the interelectrode space. Specifically, this model applies to a broad-spaced plasma diode where the spacing is many times the mean free path. No specific mechanism and rates for volume ionization and recombination were assumed; both the net volume ionization and the plasma electron temperature were treated as unknown parameters. The basic assumptions used are included. Using these assumptions, a set of six simultaneous equations were formulated to describe the condition when the emitter sheath vanishes. Special numerical procedures developed to solve these six equations are discussed. E.E.B.

N65-19868*# Naval Ammunition Depot, Crane, Ind. Quality Evaluation Lab.

EVALUATION PROGRAM FOR SECONDARY SPACECRAFT CELLS. ACCEPTANCE TEST OF GULTON INDUSTRIES, INC. 12 AMPERE-HOUR CELLS

E. C. Bruess 16 Feb. 1965 14 p

(NASA Order W-11252-B)

(NASA-CR-57470; QE/C-65-124) CFSTI: HC $1.00/MF $0.50

Thirty cells, rated at 12 A-h, were acceptance tested. The ceramic seals were satisfactory, with no leaks detected in any cell. The capacity was in the acceptable range of 13.65 to 15.5 A-h. E.P.V.

N65-19897*# Westinghouse Electric Corp., Lima, Ohio. Aerospace Electrical Div.

BRUSHLESS D.C. TORQUE MOTOR Second Quarterly Report, 25 Sep.–25 Dec. 1964

W. W. Yates and R. E. Skamfer [1964] 34 p

(Contract NAS5-3934)

(NASA-CR-57416; WAED64.73E) CFSTI: HC $2.00/MF $0.50

This report covers the development of a brushless dc torque motor. All manufactured and purchased components were prepared, and some general design considerations which arose after the initial design period were resolved. A research report on the solid lubricant bearings to be used in these motors is included. Author

N65-19916*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

LABORATORY EXPERIMENTS ON THE PERFORMANCE OF SILICON SOLAR CELLS AT HIGH SOLAR INTENSITIES AND TEMPERATURES

Phillip A. Johnston Washington, NASA, Mar. 1965 26 p refs (NASA-TN-D-2733) CFSTI: HC $1.00/MF $0.50

Experiments were conducted to evaluate the performance of silicon solar cells at high temperatures and incident solar energies. The solar cells tested were silicon N/P type with a manufacturer's efficiency rating of 12%. Each cell was equipped with a protective cover slide. The quantum efficiency of each cell was measured at various wavelengths and at temperatures ranging from 303° to 463° K. These measurements were made for correlating the laboratory experiments with projected outer space performance. Power output variations due to changes in the angle-of-incidence were also measured. Test results are presented on the basis of distance from the sun. The maximum power output is predicted for a solar cell approaching the sun at angles of 0°, 45°, 60°, and 80°. It appears that silicon solar cells could be used near the sun when inclined at large angles to the incident solar energy. For example, at an angle of 80° it is estimated that the silicon solar cells tested could approach the sun to within approximately 0.2 astronomical unit without exceeding an assumed upper limiting temperature of 463° K. Author

N65-19929*# Naval Ammunition Depot, Crane, Ind.

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION SPACE CELL TEST PROGRAM Monthly Progress Report

E. R. Pettebone and V. Yeager 28 Feb. 1965 113 p

(NASA-CR-57404) CFSTI: HC $4.00/MF $0.75

Five- and ten-cell packs of nickel–cadmium, ten-cell packs of silver–cadmium, and five-cell packs of silver–zinc cells underwent life cycle tests after each pack was given a capacity test at its respective cycling temperature. Test parameters were ambient temperatures, voltage limits per pack on charge, depth of discharge, and orbit times. Data sheets give the end of discharge and the end of charge voltage readings for each cell on each cycle recorded. G.G.

N65-19981# Lockheed Missiles and Space Co., Sunnyvale, Calif.

PROGRAM ROE (REFLECTOR ORBITAL EXPERIMENT). PART III: PRELIMINARY DESIGN: INFLATABLE RIGIDIZED SOLAR REFLECTOR CONCEPT. VOLUME I: THE TEN-FOOT-DIAMETER DESIGN

L. Manning (Goodyear Aerospace Corp.) Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 78 p

(Contract AF 33(657)-10668)

(AFAPL-TR-64-132, Pt. III, V. I; LMSC-A702683; AD-612460)

The conceptual design configuration and a preliminary design analysis are presented for a 10-foot-diameter, 60°-rim-angle, inflatable, rigidizable concentrator. The design of instrumentation for focal-zone, heat-flux measurement and reflectance degradation detection is described. An estimated weight summary, mass properties and distribution data, and estimated power requirements are presented. Author

N65-20001# Thermo Electron Engineering Corp., Waltham, Mass.
THERMIONIC CONVERTER LIFE AND REPEATABILITY INVESTIGATION Technical Report, 2 Jan.–31 Dec. 1964
C. Zelman Kamien, J. H. Weinstein, and Firooz Rufeh 31 Jan. 1965 137 p refs
(Contract AF 33(615)-1348)
(TE-41-65; AFAPL-TR-65-7; AD-612050)

Life-test equipment was designed and built to make possible testing of converters for long life as well as for cycling evaluation, with diagnostic facilities incorporated in the design of the life-test station. These diagnostic facilities include equipment for the evaluation of gas evolution in the converters during life testing. In order to obtain significant data from the gas sampling effort, a new technique was developed to analyze the minute quantities of gas which may evolve in the course of diode operation. Results from the outgassing of one converter are presented. The results indicate that copper members of the converter require about three times the outgassing period of any other materials. The predominant gas was found to be hydrogen for copper, and hydrogen and carbon monoxide in equal amounts for the emitter and collector. Design details and life-limiting characteristics of the converter are described. Discussion of a thermionic scanner, its design details, and its mode of operation are given. The data obtained by scanning a vapor-deposited rhenium-on-tungsten emitter are discussed. Author

N65-20043# Inland Testing Labs., Dayton, Ohio.
ALKALINE CELL EVALUATION AND ANALYSIS Quarterly Technical Progress Report, 15 Nov. 1964–15 Feb. 1965
P. R. Voyentzie 15 Feb. 1965 36 p
(Contract AF 33(615)-1580)
(QTPR-3; AD-611850)

In a secondary battery applied research and failure analysis program, the purpose is to determine the actual failure mechanism of all components of alkaline storage batteries, the techniques and materials necessary to prevent these premature failures, and to devise analytical methods for predicting the life of cells under any environmental condition. The program is also concerned with determining methods for gas suppression and the hermetic sealing of alkaline cells. The program has five parts: investigation of seals, investigation of cell operating variables, investigation of memory effects, investigation of variables, and evaluation of new or improved cells. Author

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; protective clothing and equipment; physiological and psychological factors. For related information see also: 05 Biotechnology.

N65-18847# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISTURBANCES IN PURKINJE FALSE IMAGES IN NEUROSES AND CERTAIN PSEUDONEUROSES INVESTIGATED BY THE OPTOINDUCOGRAPHIC METHOD
J. Vyskocil and L. Vojtanova 14 Nov. 1964 16 p refs Transl. into ENGLISH from Cesk. Neurol. (Czechslovakia), v. 26, no. 4, Jul. 1963 p 271–279
(FTD-TT-64-52/1+2; AD-452068)

Optoinducographic methods were employed to observe the false images of 52 neurotics and 53 pseudoneurotics. Measurement criteria were the threshold sensitivity, duration of latency and false image, sizes, clearness of contours, movement, rate of appearance and disappearance, and the color of the false image. It was found that neurotics had 90% false images in a complementary color, and only perhaps 10% of them in gray, whereas pseudoneurotics with arteriosclerosis or with hypertension had gray false images in 86% and 70%, respectively, either at short exposure or at disappearance or repeated false images. The fact that the remaining qualities of Purkinje false images among neurotics and pseudoneurotics were almost identical is considered as a sign of pathophysiological and pathogenic affinity of neurosis and pseudoneurosis. G.G.

N65-18884# School of Aerospace Medicine, Brooks AFB, Tex.
ENGINEERING CONSIDERATIONS IN GSR RESEARCH Aeromedical Review No. 4–64
William H. Rickles, Jr. Nov. 1964 22 p refs
(AD-610222)

The critical methodological points involved in studying galvanic skin reflexes (or resistance, both aspects of the same phenomenon and abbreviated GSR) are summarized to assist those concerned with fabricating GSR recording apparatus. The design characteristics pertinent to nine elements of GSR detection circuitry are discussed. R.L.K.

N65-18881# Naval Air Development Center, Johnsville, Pa. Aviation Medical Acceleration Lab.
HEMODYNAMIC AND CINE-RADIOGRAPHIC STUDY OF TRANSVERSE ($+G_x$) ACCELERATION
Harold Sandler 21 Sep. 1964 54 p refs
(NADC-ML-6413; AD-457840)

Cardiopulmonary hemodynamics were studied in dogs during acceleration of +5 G_x, +10 G_x and +15 G_x on the Johnsville centrifuge. Changes in cardiopulmonary parameters were correlated with changes in the heart and lungs recorded by cineradiography and cineangiocardiography using a 9-inch image intensifier X-ray system. Decreases in cardiac output and stroke volume were recorded by dye dilution techniques in all animals and confirmed by cineangiocardiographic studies. A marked and consistent fall in arterial oxygen saturation was also recorded. The role of atelectasis as the cause for this fall in oxygen saturation was discussed. Author

N65-18886 Library of Congress, Washington, D. C. Aerospace Technology Div.
BIOLOGICAL AND MEDICAL ASPECTS OF MICROWAVES
Christopher Dodge *In its* Foreign Sci. Bull. Feb. 1965 p 7–19 refs (See N65-18884 09-34)

A review is presented of recent Soviet research on the effects of microwaves on the state of the nervous system. This is based on 12 articles published by prominent authors in this field during the period 1958–1964. Experimental methods, instrumentation, and various observed effects of microwaves on the animal and human nervous systems are discussed. Author

N65-18889 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE INFLUENCE OF MICROWAVES ON THE FUNCTIONAL CONDITION OF THE NERVE
Christopher Dodge *In its* Foreign Sci. Bull. Feb. 1965 p 33–38 ref (See N65-18884 09-34)

The results of investigations of the functional state of the frog nerve (n. ischiadicus) during irradiation with microwaves are described. Included in the study were considerations of excitability thresholds, rate of the conduction of excitation, absolute and relative refractory phases, and amplitude of action currents during irradiation with microwaves of nonthermal intensity in pulsed and nonpulsed systems. Author

N65-18915*# Public Health Service, Washington, D. C. Communicable Disease Center
REDUCTION OF BACTERIAL DISSEMINATION GERMICIDAL ACTIVITY OF ETHYLENE OXIDE. REDUCTION OF BACTERIAL CONTAMINATION ON SURFACES Second Quarterly Summary Report of Progress
Feb. 1965 6 p
(NASA Order R-137)
(NASA-CR-57148) CFSTI: HC $1.00/MF $0.50

Two adult male humans were tested in a microbiotank facility for whole-body shedding of viable particles (such as bacteria). Duration of confinement, number of trials, type of clothing, previous cleansing of the skin, and mean rate of shedding are tabulated for each subject. A wide variation was found in high shedding rates between subjects in normal street clothes, while the high shedding rates were reduced to almost nominal levels by taking a long shower with a standard hospital-type detergent containing hexachlorophene and then donning a sterile scrub suit, socks and cap. In an effort to reduce bacterial contamination on surfaces, a closed-circuit system for controlled rates of reduction of the relative humidity of the test atmosphere was fabricated. Progress on an investigation of the germicidal activity of ethylene oxide is reported. D.E.W.

N65-18921*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE IONIZING RADIATIONS IN SUPERSONIC TRANSPORT FLIGHTS
Trutz Foelsche [1964] 20 p refs Presented at the 2d Symp. on Protect. Against Radiation in Space, Gatlinburg, Tenn., 12–14 Oct. 1964
(NASA-TM-X-56122) CFSTI: HC $1.00/MF $0.50

Commercial supersonic transport planes are envisioned to cruise at altitudes up to 23 km or 75 000 feet. The exposure to crew and passengers from galactic and solar cosmic rays at these altitudes on polar routes is estimated and compared with the maximum permissible dose rates (MPD). Estimates of dose rates for the most important intense and energetic flare events (solar cosmic radiation) show that in cruise altitudes at high latitudes and in impact zones, e.g., during the February 23, 1956 event, 1 to 4 rem/hr might have been reached. Such doses are undesirable, even if their occurrence is very rare. If evasive measures are carried out in these cases, such as descending to 40 000 feet (12 km), the radiation doses received by passengers appear negligible (≈10% of the MPD of 0.5 rem/year at 2 polar flights/month) except for the effects of certain characteristic biological effective components of galactic cosmic rays which appear only in high altitudes, i.e., heavy primaries and stars. Author

N65-18967# Industrial Biology Research and Testing Labs., Inc., Philadelphia, Pa.
CUTANEOUS TOXICITY EVALUATION OF AIR FORCE DEVELOPMENT MATERIALS, VII Technical Report, Jun.–Oct. 1964
Morris V. Shelanski Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 21 p refs
(Contract AF 33(615)-1571)
(AMRL-TR-64-120; AD-610520)

Five Air Force development materials were studied via the prophetic patch test method on laboratory animals to determine the primary irritant effect, gross sensitization index, and gross percutaneous toxicity of these materials. The patch test studies with rabbits indicated that two of the materials produced severe primary irritant action. A third material produced primary irritation whose severity was not considered sufficient to preclude testing on humans. Therefore, testing on human volunteers was carried out with three of the materials. Results indicated that only one of these materials was safe to use in contact with human skin. Author

N65-18971# American Foundation for Biological Research, Madison, Wis.
INJURY CAUSED BY THE FORMATION OF ICE IN THE ISOLATED MUSCLES OF RATS
B. J. Luyet and F. W. Gonzalez Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1964 6 p refs
(Contract AF 41(657)-343)
(AAL-TDR-63-39; AD-610384)

Previous investigations showed that the feet of mice and rats can recover completely after having been exposed in the frozen state at −10° C for 10 and 20 minutes. In the present work, a study was made of the ability of a single excised component of the rat limb, namely the tibialis anticus muscle, to survive freezing. The muscle, coated with vaseline and carrying an inserted thermal junction, was immersed directly into a bath at −3°, −5°, or −10° C. When the internal temperature had dropped to −2° C, the muscle was seeded (to initiate ice formation) and maintained in the frozen state for various lengths of time. It was rewarmed by abrupt transfer to a water bath at 35° C and tested for its ability to contract when electrically stimulated. In baths at −3° C the muscles survived 40 to 45 minutes in the frozen state, in baths at −5° C they survived 15 minutes but not 20 minutes, and no survival was obtained in muscles kept frozen for even only 1 minute at −10° C. Author

N65-18972# American Foundation for Biological Research, Madison, Wis.
COMPARATIVE STUDY OF FREEZING INJURY IN A HIBERNATOR AND A NONHIBERNATOR
B. J. Luyet and R. J. Williams Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1964 8 p refs
(Contract AF 41(657)-343)
(AAL-TDR-63-39; AD-610388)

An attempt is made to ascertain whether the ability of the hamster to escape freezing injury may be related to its ability to hibernate. The feet of hamsters, in the nonhibernating state, and of albino rats were cooled at ambient temperatures of −10°, −8°, −6° and −4° C, seeded when the center of the paw had reached a given below-freezing temperature, and maintained in the frozen state for various lengths of time. It was found that, while the course of temperature during cooling and freezing and the general appearance of the limb in the frozen state did not differ significantly in the two animals, the subsequent manifestations of injury and the extent of recovery did. The amount of swelling was considerably more in rats than in hamsters. Hamsters' paws frozen for 20 minutes in −10° C recovered more rapidly than rats' paws treated in the same way; hamster limbs frozen for 1 hour at −10° C recovered completely, while rat limbs similarly frozen showed necrosis. Author

N65-18973# Utah Univ., Salt Lake City. College of Medicine
EFFECT OF DIFFERENT ROUTES OF CHALLENGE OF COXSACKIE B VIRUS ON COLD-STRESSED MICE

Stanley Marcus and Fred Miya Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1964 10 p refs
(Contract AF 41(657)-311)
(AAL-TDR-64-2; AD-610389)

Adult albino mice were given Coxsackie B virus via intrathoracic, intraperitoneal, intranasal, and aerosol routes. The mice were either acclimatized or unacclimatized to 2° C ambient temperature, and in one challenged group normal mice were compared to specifically immunized animals. No deaths occurred in the control animals (21° C) challenged intranasally or by aerosol; however, 5/10 mice were killed by the intrathoracic challenge and 1/10 died from the intraperitoneal challenge. In general the mice unacclimatized to 2° C had higher mortality ratios than acclimatized animals in all challenged groups regardless of the route of challenge. Intranasally and intraperitoneally challenged mice had similar mortality ratios in all groups tested. Many of the deaths of the intrathoracically challenged mice are attributed to the procedure of challenge. The few deaths in the aerosol challenged groups are thought to be a dose-related factor. Author

N65-18974# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.
THE EFFECTS OF DIET ON HMP DEHYDROGENASE AND MALIC (TPN) DEHYDROGENASE IN THE RAT
David A. Vaughan and Robert L. Winders Oct. 1964 13 p refs
(AAL-TDR-64-13; AD-610611)

The effects of several types of diets and feeding procedures upon the activities of hexosemonophosphate (HMP) dehydrogenase and malic (TPN) dehydrogenase were studied in rats. Inclusion of dietary fat at levels 15% or above depressed activity of both enzymes. Diets high in protein, and containing only 2% carbohydrate, depressed the activity of malic (TPN) dehydrogenase but had no effect on HMP shunt dehydrogenase. Fat, fed concurrently with carbohydrate, depressed activity of both enzymes but had little effect when fed on alternate days. Regeneration of HMP dehydrogenase activity after fasting was greatest during 75% protein + 17% alanine refeeding, followed in intensity by 90% protein, 75% protein + 17% glutamic acid, and least on an N-free high carbohydrate diet. Malic (TPN) dehydrogenase, under these circumstances, was stimulated only by the N-free high carbohydrate diet. Substitution of starch or dextrin for glucose in high carbohydrate diets had a depressing effect on both of the enzymes studied. Author

N65-18999# California Univ., Davis. Agricultural Experiment Station
RADIATION TECHNOLOGY IN CONJUNCTION WITH POSTHARVEST PROCEDURES AS A MEANS OF EXTENDING THE SHELF LIFE OF FRUITS AND VEGETABLES Annual Report, Feb. 1, 1963–Jan. 30, 1964
E. C. Maxie, N. F. Sommer, and D. S. Brown Washington, AEC, Nov. 1964 171 p refs
(Contract AT(11-1)-34)
(UCD-34P80-2) CFSTI: $5.00

It appears that irradiation will not be an all-inclusive technology for fruits and vegetables. If it has a role, it will likely be confined to a limited number of species or varieties, perhaps at certain physiological stages. Irradiation technology is most likely with fruits that have a relatively short postharvest life. The most promising fruit studied was the strawberry; 200 Krad of gamma irradiation appeared to reduce decay substantially under simulated transit conditions without severe damage to quality. Sweet cherries also showed some promise, although there was a loss in texture which would have to be evaluated in commercial shipments. Table grapes and lemons destined for long-term storage were poor subjects for irradiation. Washington Navel oranges responded favorably. Some benefits were observed from irradiation of dewberries, figs, pineapples, raspberries, peaches, nectarines, and asparagus. Gamma irradiation appeared to have limited application for tomatoes, although the possibility of combining ethylene treatment and irradiation showed promise. Radiation did not increase the storage life or quality of slicing cucumbers. Also discussed are radiation mycology, quantitative dose-response of prunus fruit-decay fungi to gamma irradiation, and the sensitivity of citrus fruit decay to gamma irradiation. R.L.K.

N65-19005# TRW Semiconductors, Inc., Lawndale, Calif. Research and Development Dept.
PRODUCTION ENGINEERING MEASURE: TRANSISTOR, VHF, SILICON, POWER (5W-70mc) Final Report, 1 Jun. 1961–31 Mar. 1964
B. Rappaport [1964] 254 p
(Contract DA-36-039-SC-85960)
(TE-4000-15-F; AD-609741)

Advances in the device and package design are discussed as well as process improvements which were instituted. A description is given of the necessary special fabrication and test equipment. The pilot run is summarized in terms of performance achieved and available capacity of the pilot production line. Test results of the preproduction samples and the final acceptance samples are given. Information necessary to the reproduction of the pilot run is presented including input parameters, a flow chart, and a process manual. Author

N65-19038*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY A Continuing Bibliography
Feb. 1965 112 p refs
(NASA-SP-7011(08)) CFSTI: HC $1.00/MF $0.75

An annotated bibliography is given of unclassified reports and journal articles that were introduced into the NASA information system during this period. The subject matter covers biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the atmosphere or in space. These references were announced previously in separate publications by the Library of Congress, the American Institute of Aeronautics and Astronautics, and NASA. The references are indexed by subject, corporate source, and personal author. R.L.K.

N65-19139# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OXYGENATION OF BRAIN TISSUES DURING AIR AND OXYGEN RESPIRATION WITH AN ADMIXTURE OF CO_2
Ye. A. Kovalenko, V. L. Popkov, and I. N. Chernyakov 23 Nov. 1964 13 p refs Transl. into ENGLISH from Fiziol. Zh. SSSR (Moscow), v. 50, no. 2, 1964 p 177–182
(FTD-TT-64-634/1+2+4; AD-609135)

The dynamics of O_2 in brain tissues during respiration of gas mixtures with an increased content of O_2 and CO_2 is presented. There is an absence of a directly proportional dependence between O_2 tension in the blood and in the brain tissues; with an increase of oxygen tension (pO_2) of 1.5 to 2 times in brain tissues, the pO_2 in the lungs and in the blood is increased 5 to 6 times. The experiments were conducted on dogs using chronically implanted electrodes in the brain, and the pO_2 was determined in the cortex and the subcortex. The gas mixtures were specially developed and fed through a hermatic mask into

the respiratory tract of the animal. It is concluded that the oxygen tension in the cortex and the subcortex is increased during respiration of air with 5% and 10% CO_2 added; respiration of pure oxygen and of the gas mixture oxygen with 5% to 10% CO_2 also increases the oxygen in the brain tissues. R.W.H.

N65-19148# Göttingen Univ. (West Germany). Physiological Inst.

RESEARCH ON CARDIAC PRESSORECEPTORS Technical Report, 1 Jan. 1962–31 Jan. 1964

K. Kramer Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 30 p refs

(Grant AF-EOAR-61(052)-541)

(AMRL-TR-64-94; AD-611563)

Pressoreceptor reflexes affecting coronary blood flow were investigated. No indication of reflexly induced changes of coronary vascular resistance was found. Peripheral vagal stimulation resulted in a 25% increase in diastolic flow indicating vagal influence on the resistance of coronary vessels. Adrenalin injected into a coronary branch led to dilation prior to its effect on the contractile force of the heart. The effects of two representative catecholamines on coronary blood flow were investigated. Using a beta-receptor blocking agent, both constrictor and dilator effects have been observed following adrenergic stimuli. Separate pressure elevation in the main trunk of the left coronary artery caused peripheral dilation. Bradycardia was also observed. Although this is believed to be a part of a depressor reflex action, there is no evidence that there exists within the coronary vessels a separate reflexogenic area comparable in intensity to the aortic arch and carotid sinus. Author

N65-19151# Oregon State Univ., Corvallis. Science Research Inst.

FATE OF UDMH AND MMH IN RATS Technical Report, 1 Jun. 1963–30 Jun. 1964

F. N. Dost, D. J. Reed, and C. H. Wang Wright-Patterson AFB, Ohio, \MRL, Dec. 1964 30 p refs

(Contract AF 33(657)-11757)

(AMRL-TR-64-111; AD-610589)

Many of the applications of hydrazines, especially as rocket propellants and in medicine, give them considerable toxicological importance. The respiratory and urinary excretion by rats of unsymmetrical dimethylhydrazine (UDMH) and monomethylhydrazine (MMH) and their metabolites has been studied by means of radiotracer techniques. At a very low dose, almost 30% of the C^{14} from i.p.-administered UDMH-C^{14} appeared as respiratory $C^{14}O_2$ in 10 hours. At a convulsive dose, the conversion of UDMH-C^{14} to $C^{14}O_2$ amounted to slightly greater than 13% at the end of 20 hours. At all doses studied radioactivity appeared in the urine to the extent of at least 50% of the administered UDMH-C^{14}, at the end of 2 days after administration. Rats administered MMH-C^{14} by i.p. injection at 20% of a median lethal dose respired approximately 45% of the administered radioactivity in 24 hours. At the subconvulsive doses, 40% of the administered radioactivity in MMH-C^{14} was excreted in urine. At a toxic dose the percentage of urinary excretion of C^{14} decreased, but net molar excretion increased slightly. Author

N65-19152# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Biophysics Lab.

A SIMPLE CAPACITIVE DISPLACEMENT MEASURING SYSTEM Final Report, Mar. 1962–Jul. 1964

Lothar O. Hoeft Dec. 1964 23 p refs

(AMRL-TR-64-116; AD-610286)

This report presents the theory, development and performance of a capacitive displacement detector. The detector senses the displacement changes as changes in the capacitance of a probe located near the body whose displacement is being measured. These capacitance changes are converted into frequency changes by placing the capacitance probe in the tank circuit of an oscillator. The frequency changes are converted into voltage changes by standard FM techniques. The capacitance detector has a sensitivity of 30 volts/ρfd. When used with a 0.2-cm diameter probe, the displacement sensitivity was 4.78 volts/cm when the probe to surface distance was 0.1 cm. The noise level was low enough so that the system was able to measure displacements of the order of 10^{-5} cm at frequencies below 1000 cps and displacements of the order of 5×10^{-6} cm at frequencies above 1000 cps. The main advantage of this type of displacement detector over others is the ease of construction and adjustment. Author

N65-19153# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio. Biomedical Lab.

UNDERWATER PRESSURE-COMPENSATED BREATHING CONTROL VALVES FOR PROLONGED WATER IMMERSION Final Report, Feb. 1960–Jun. 1962

Henry W. Seeler Dec. 1964 15 p ref

(AMRL-TR-64-130; AD-611807)

Two water-pressure-compensated breathing devices for prolonged immersion have been designed, fabricated, and tested underwater. One valve is a continuous-flow regulator and the other is a demand regulator. Both valves allow exhalation through a hose directly into the surface atmosphere for air analysis. One of the two valves has been used extensively during prolonged weightlessness simulation tests by immersion. Author

N65-19154# Institute of Occupational Health, Helsinki (Finland). Dept. of Physiology

TEMPERATURE OF THE HUMAN BODY DURING RAPID ALTERNATE HEATING AND COOLING Final Report, May 1963–Apr. 1964

Pekka Piironen and Erkki Aikas Wright-Patterson AFB, Ohio, AMRL, Dec. 1964 37 p

(Grant AF-EOAR-63-113)

(AMRL-TR-64-131; AD-611805)

Eight nude resting male subjects were immersed in water. The temperature of the bath was varied cyclically from −5° to 42° C. Similar experiments were performed in air with temperatures varying from −5° to 120° C. Skin temperatures oscillated sinusoidally with amplitudes varying from 1° to 10° C and periods varying from 3.75 to 30 minutes. Variations in skin temperature below 30° C did not affect the oesophageal temperature. Sinusoidal variations in skin temperature above 34° C were reflected in nearly sinusoidal alterations in the oesophageal temperature. Sinusoidal variations in oesophageal temperature were accompanied by nearly sinusoidal alterations in rectal, sublingual, and tympanic membrane temperatures, with damping characteristics and phase shifts typical for each site of measurement. Author

N65-19187# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONTRIBUTION TO METHODS OF EVALUATING THE ANALGESIC EFFECT OF DRUGS

M. Lukasiewicz and E. Fraenkel 14 Nov. 1964 14 p refs Transl. into ENGLISH from Cesk. Farm. (Prague), v. 12, no. 2, Feb. 1963 p 85–89

(FTD-TT-64-55/1+2; AD-452443)

Analgesic effects of drugs and a useful method for studying these effects are described. The method is based on registering and measuring the reaction toward painful stimuli and also respiratory excursions. An evaluation of the analgesic effect of oxycodeine chloride is given. The effect of drugs on motion reactions produced by painful stimuli was evaluated on the basis of the number of rats which reacted to stimuli after application of uniform dosages of oxycodeinene at uniform time intervals, and ED_{50} of oxycodeinene chloride at uniform time intervals was established. R.W.H.

N65-19194# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHARACTER OF CHANGES IN THE BLOOD IN PERSONS WINTERING AT THE VOSTOK STATION

I. I. Tikhomirov 20 Nov. 1964 7 p Transl. into ENGLISH from Byul. Sov. Antarkt. Ekspeditsii (USSR), no. 31, 1961 p 44–47 (FTD-TT-64-285/1; AD-609151)

The relative blood hemoglobin level of nine men wintering in the Russian polar region at average temperatures of −44.5° at average pressure of 470.8 mm Hg increased 62.5% in the first 2 1/2 months, and continued to increase by an average of 10% during the next 4 months. The number of erythrocytes reached the maximum earlier than the amount of hemoglobin, and lagged behind the increase of hemoglobin sufficiently to change the blood color index. Pronounced leucopenia was induced by (1) the living conditions in an almost completely sterilized medium, (2) the depression of the hemopoietic functions by the shaking and vibration of the observation ship, and (3) the insufficiency of ultraviolet radiation. No changes in the blood composition were observed that could be correlated with the season of the polar year, the polar day, or the polar night. G.G.

N65-19197# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CHANGES IN HIGHER NERVOUS ACTIVITY AND IN CERTAIN VEGETATIVE REACTIONS DURING LONG PERIODS OF RELATIVE ADYNAMIA AND ISOLATION

N. A. Agadzhanyan, Yu. P. Bizin et al 23 Nov. 1964 19 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 13, no. 6, 1963 p 953–962 (FTD-TT-64-635/1+2+4; AD-609152)

The work capability of man under conditions of relative adynamia and isolation was determined primarily from the capability to rapidly and accurately differentiate and solve mental problems of varying complexity, while maintaining a high level of movement coordination when performing purposeful actions. Method of experimentation and results are reported. E.E.B.

N65-19211# Chicago Univ., Ill.

RADIATION LABORATORY QUARTERLY PROGRESS REPORT NO. 54

Kenneth P. Du Bois 15 Jan. 1965 101 p refs (Contract AF 41(609)-1693) (AD-610947)

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2. INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A DETOXIFICATION SYSTEM FOR PHOSPHOROTHIOATES IN THE LIVERS OF RATS F. Kinoshita and K. P. Du Bois p 15–28 refs (See N65-19213 09-04)

3. THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE V. J. Pizak, M. Root, and J. Doull p 29–44 refs (See N65-19214 09-04)

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N65-19212 Chicago Univ., Ill.

STUDIES ON THE EFFECT OF X-IRRADIATION ON COENZYME A LEVELS OF THE LIVERS OF MICE

Kei-ming Yam and Kenneth P. Du Bois *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1965 p 1–14 refs (See N65-19211 09-04)

The concentration of CoA in extracts of livers of normal and X-irradiated mice was determined using an in vitro acetylation system in which CoA was the rate-limiting component. Concentration of CoA in the livers of mice exposed to 700 r whole-body irradiation showed no significant change from normal immediately after irradiation. A 20% decrease occurred 6 hours after irradiation, followed by a 70% increase 2 days after irradiation, a 35% decrease at 8 days, and return to normal by the 10th day. Since the transient effects do not appear to be large enough to interfere with normal metabolic processes which require CoA, these results substantiate previous findings that X-irradiation does not affect the ability of animals to acetylate foreign compounds. M.P.G.

N65-19213 Chicago Univ., Ill.

INFLUENCE OF X-IRRADIATION ON THE DEVELOPMENT OF A DETOXIFICATION SYSTEM FOR PHOSPHOROTHIOATES IN THE LIVERS OF RATS

Florence Kinoshita and Kenneth P. Du Bois *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1965 p 15–28 refs (See N65-19211 09-04)

The influence of sublethal doses of X-rays on the development of the microsomal enzyme that catalyzes the coupled desulfuration and hydrolysis of phosphorothioates was investigated in mice. The hydrolytic enzyme, as well as the desulfuration system, was found to be inhibited by doses of 400 and 600 r, indicating that the inhibitory effect of radiation on enzyme synthesis extends beyond the area of oxidative microsomal enzymes. Since the hydrolysis occurs at a much more rapid rate than desulfuration, desulfuration is considered to be responsible for the inhibition of the overall system. Daily administration of phenobarbital and nikethamide markedly stimulated the phosphorothioate EPN detoxification enzyme system; the effects of radiation on this stimulatory effect are being investigated. In another series of experiments, chronic exposure to 21.2 or 50 r gamma irradiation per day resulted in no inhibition of the synthesis of the detoxification system even though some animals received large cumulative doses. M.P.G.

N65-19214 Chicago Univ., Ill.

THE INFLUENCE OF VARIOUS CHEMICAL COMPOUNDS ON RADIATION LETHALITY IN MICE

V. J. Plzak, M. Root, and J. Doull *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1964 p 29–44 refs (See N65-19211 09-04)

Thirty-five chemical compounds were evaluated for protective activity against the lethal effects of whole-body X-irradiation in mice. Most of the compounds were selected because of a structural similarity to proven radioprotective compounds. The results of toxicity and radiation tests are tabulated for each compound. None of the five quinazoline derivatives tested exhibited significant radioprotective activity, nor did the quinazolinol or quinolinol derivatives. However, two quinolines permitted 10% of the mice to survive an otherwise lethal dose. Slight prolongation of survival time resulted from premedication with three thiazolidine derivatives. Dosage was found to be a significant factor in the radioprotective activity (up to 30% survival) of a thiocarbamic acid derivative and a thiocyanic acid derivative administered prior to irradiation. Two imidazole derivatives were not radioprotective and were quite toxic. The protective and toxic effects of a group of halogenated and methylated nitrosalicylanilides are discussed in relation to the number and position of methyl and chloro groups. A compound, Complamex, introduced in Europe as a therapeutic for radiation sickness, was found to offer no significant protection either before or after lethal X-ray exposure. M.P.G.

N65-19215 Chicago Univ., Ill.

DOSE-MORTALITY RELATIONSHIPS FOR SEVERAL RADIOPROTECTIVE AGENTS

V. Plzak and J. Doull *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1965 p 45–63 refs (See N65-19211 09-04)

The dose reduction factor (DRF) was determined for six radioprotective compounds in mice exposed to whole-body doses of 600 through 900 r. These calculations are based on the ability of the compounds to reduce radiation mortality at 30 days after exposure, and are calculated using a programed maximum likelihood estimate procedure. Results indicate that the most effective agent tested was 1-thioglycerol (DRF = 1.28). Values of about 1.2 DRF were obtained with 2-benzoxazolethiol, N,N′-bis-(2-hydroxyethyl) dithiooxamide, B,B′-dimethyl aminoethyl isothiouronium sulfate, and N,N′-di(9-xanthenyl) dithiooxamide. The dimethylammonium salt of dimethyl dithiocarbamic acid exhibited a DRF of 1.16. Other studies indicate that increasing the dose of p-aminopropiophenone (PAPP) from 15 to 45 mgm/kgm IP does not increase the radioprotective effect of this compound against whole-body X-ray exposure in mice. M.P.G.

N65-19216 Chicago Univ., Ill.

STUDIES ON THE RELATIONSHIP BETWEEN SPLEEN OXYGEN TENSION AND RADIOPROTECTION IN MICE

A. Hasegawa and H. D. Landahl *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1965 p 64–69 refs (See N65-19211 09-04)

The LD_{50} values in the mice forced to breathe 10%, 7%, or 4.6% oxygen during X-ray exposure were 620 R, 860 R, and 1000 R, respectively. The LD_{50} values in the mice maintained at 10% oxygen for a period of 10 minutes, but irradiated under the same conditions as above, were 590 R at 10% and 995 R at 4.6%. Thus, prior administration of 10% oxygen did not alter the survival of these mice. The oxygen tension in the spleen of mice breathing 10%, 7%, or 4.6% oxygen decreased to 36%, 31%, and 10% of normal, respectively. The oxygen tension in the spleens of mice administered 10% oxygen for 10 minutes and subsequently measured while breathing 10%, 7%, or 4.6% oxygen were 26%, 22%, and 12% of normal, respectively. The oxygen tension in the mice given prior treatment with 10% oxygen reached slightly lower levels. Author

N65-19217 Chicago Univ., Ill.

EFFECTS OF ACUTE AND CHRONIC EXPOSURE TO HYPERBARIC OXYGEN ON THE SURVIVAL OF NORMAL AND X-IRRADIATED ANIMALS

John Doull, Eric L. Simmons, Vivian J. Plzak, and Edna L. Marks *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1965 p 70–88 refs (See N65-19211 09-04)

The effects of hyperoxia and hypoxia on acute radiation lethality were investigated in mice exposed to 400 to 800 r X-irradiation while in environments from 1/10 to 7 atm of oxygen. Irradiation at high oxygen pressure (up to 90 psig) did not markedly increase radiation susceptibility, indicating the validity of using high oxygen pressure as a research tool in studying radioprotective agents that act through a hypoxic mechanism. In other studies, the ability of various strains of mice, rats, and rabbits to withstand chronic exposure to high oxygen pressure was established. A treatment cycle that permits mice and rats to withstand prolonged exposure (over 60 days) to hyperbaric oxygen is discussed. Young animals were found to be more resistant to the toxic effects of chronic hyperbaric exposure than older animals; this effect does not appear to be related to differences in body size and weight. The symptoms of oxygen toxicity were found to be similar in male and female animals. M.P.G.

N65-19218 Chicago Univ., Ill.

APPLICATION OF RADIATION-INDUCED CHANGES IN ADENOSINE TRIPHOSPHATASE ACTIVITY OF HEMATOPOIETIC TISSUES TO A STUDY OF CHRONIC GAMMA IRRADIATION AND THE INFLUENCE OF VARIOUS FACTORS ON ACUTE RADIATION INJURY

Robert Tardiff and Kenneth P. Du Bois *In its* Radiation Lab. Quart. Progr. Rept. No. 54 15 Jan. 1965 p 89–98 refs (See N65-19211 09-04)

Adenosine triphosphatase was assayed in the spleen and thymus of weanling and adult male rats exposed to chronic gamma irradiation at 21.2, 45.0, and 50.4 r per day over a period of 10 hours a day for extended time periods. The increases in adenosine triphosphatase activity of the spleen ranged from 133% to 156% of normal; the extent of the increase was dependent upon the total dose of radiation; and the effect was somewhat greater in weanlings than in adults. The data suggest that the enzyme activity increased to a maximum level for a particular dose during the early part of the exposure and was maintained at a constant level thereafter. Although the dose–response relationship needs further study, the results indicate the usefulness of the assay in investigating factors or drugs that influence chronic irradiation response. The enzyme activity of the thymus was not appreciably affected, nor was the development of the phosphorothioate detoxifying system in the liver, at least to 45 days of age. Castration 30 min after X-irradiation did not influence the amount of radiation injury to the spleen and thymus on the third day after irradiation. M.P.G.

N65-19261*# Biosystems, Inc., Cambridge, Mass.

BIOLOGICAL CONTROL SYSTEMS—A CRITICAL REVIEW AND EVALUATION, DEVELOPMENTS IN MANUAL CONTROL

Lawrence R. Young and Lawrence Stark Washington, NASA, Mar. 1965 225 p refs

(Contract NAS2-1372)

(NASA-CR-190) CFSTI: HC $6.00/MF $1.25

Recent developments in mathematical models for the human manual control system are reviewed and evaluated as part of a study of the field of biological control systems. Application of control models for investigation of the "fine structure" is stressed, rather than human engineering aspects. Evidence

for and against discrete models of the human operator is presented, and a number of such models are compared. The adaptive characteristics of the operator and two basic modeling approaches are presented; several models are reviewed. Detailed discussion is included on correlation of manual response characteristics and physiological data for muscle, leading to models for the postural control and voluntary control system interactions. Author

N65-19271*# National Aeronautics and Space Administration, Washington, D. C.
A CUMULATIVE INDEX TO THE 1964 ISSUES OF A CONTINUOUS BIBLIOGRAPHY ON AEROSPACE MEDICINE AND BIOLOGY
Feb. 1965 562 p Supersedes indexes to SP-7011 and SP-7011(01)–SP-7011(06)
(NASA-SP-7011(07)) CFSTI: HC $5.00/MF $2.75

N65-19289# Bryn Mawr Coll., Pa. Dept. of Biology
INFLUENCE OF CORTISONE ON GLYCONEOGENESIS, ENDOTOXIN LETHALITY AND TRYPTOPHAN PYRROLASE INDUCTION IN COLD-EXPOSED MICE
L. Joe Berry Ft. Wainwright, Alaska, Arctic Aeromed. Lab., Oct. 1964 16 p refs
(Contract AF 41(609)-1764)
(AAL-TDR-64-5; AD-610644)

Mice singly housed and exposed to 5° C are almost as responsive as animals at 25° C in carrying out glyconeogenesis following a single injection of cortisone. An LD_{50} of endotoxin lowers liver glycogen about equally in mice housed at each of the two temperatures, but the dose for mice at 5° C is one one-hundredth the dose at 25° C. Cortisone given concurrently with the endotoxin prevents glycogen depletion in mice at 25° C but not in those housed at 5° C, except possibly at certain critical doses. Cortisone also fails to induce an increase in liver tryptophan pyrrolase activity in cold-exposed mice, in contrast to those maintained at room temperature, and this failure cannot be ascribed to any alteration in hematin level, the cofactor for the enzyme. These findings are considered as evidence for an impaired capacity for protein (enzyme) synthesis in normothermic animals during acute exposure to cold. Author

N65-19326# Joint Publication Research Service, Washington, D. C.
METHODS OF DETERMINING GAS EXCHANGE THROUGH THE ENTIRE SURFACE OF THE SKIN
N. M. Petrun' 16 Mar. 1965 14 p Transl. into ENGLISH from the book "Gazoobmen Cherez Kozhu i Yego Znacheniye Dlya Organizma Cheloveka" Moscow, 1960 p 6–17
(JPRS-29142; TT-65-30523) CFSTI: $1.00

Modifications of a diver's suit for use as a minimum volume, hermetically sealed system to quantitate gas exchange through the skin are described. Hoses attached to the suit lead to water condensers, carbon dioxide absorbers, a compressor pump, and back to the suit. The suit, which covers all of the subject's body except the face, is completely evacuated and then filled with a known volume of the purified air. Gas samples from the suit are analyzed at the beginning and end of the investigation to determine the increase in carbon dioxide. Among the advantages of this setup are portability, the ability to measure skin respiration with the subject at work as well as at rest, and the possibility of simultaneous measurement of skin respiration, pulmonary respiration, temperature, and gaseous composition of venous and arterial blood. M.P.G.

N65-19331# Los Alamos Scientific Lab., N. Mex.
CALCULATION OF RETINAL DOSE DUE TO VISIBLE RADIATION FROM NUCLEAR EXPLOSIONS
Robert D. Cowan 1 Mar. 1965 102 p refs
(Contract W-7405-ENG.36)
(LA-3204-MS) CFSTI: $4.00

Calculation of the maximum energy density received by any portion of the retina due to radiation from an incompletely resolved source requires knowledge of the point-source retinal-image-spread function. For a uniform circular source, one requires more specifically: (1) the point-source effective image radius a_o, and (2) the normalized integral $g(a/a_o)$ of the image spread function out to the geometrical image radius a. The function g tends to a^2/a_o^2 for small a, to unity for large a, and in intermediate regions may be roughly characterized by its value at $a = a_o$. Experimental measurements on human eyes appear to indicate $a_o > 6\mu$ and $g(1) \cong 0.5$, but these values are uncertain. A theoretical calculation assuming only diffraction and chromatic aberration gives $a_o = 3.5\mu$ and $g(1) \cong 0.15$ for large pupils (nighttime conditions) and $a_o = 4\mu$, $g(1) \cong 0.4$ for small pupils (daytime). Less conservative results, in which effects of other aberrations have been incorporated, are $a_o \cong 7\mu$, $g(1) \cong 0.5$ for any size pupil—in reasonable agreement with experiment. The dose from a hypothetical high-altitude explosion is calculated to illustrate use of these results. Author

N65-19401*# Joint Publications Research Service, Washington, D. C.
THE UFI-63: A DEVICE FOR STUDY OF HUMAN HIGHER NERVOUS ACTIVITY
B. A. Minin 10 Mar. 1965 6 p refs Transl. into ENGLISH from Zh. Vysshei Nervnoi Deyatel'nosti (Moscow), v. 14, no. 6, 1964 p 1104–1107
(JPRS-29057; TT-65-30474) CFSTI: $1.00

Described is a device that measures different parameters of human motor and speech responses simultaneously, and records the latent periods of the motor and speech responses, the duration, and the magnitude of the motor responses. The motor response parameters are measured by the amount of lever displacement through pressure, and a throat microphone is utilized for the latent speech periods. Studies with this apparatus revealed substantial differences between individual subjects and groups of subjects with respect to the parameters of the properties of the main nervous processes. The duration of the motor responses was found to be dependent upon external factors. G.G.

N65-19416# Harry Diamond Labs., Washington, D. C.
HUMAN BREATHING PARAMETERS AND COMMERCIAL AUTOMATIC RESPIRATORS
H. H. Straub and G. Thompson 1 Jun. 1964 22 p refs
(HDL-TM-64-23; AD-609732)

During periods of inadequate human respiration, artificial ventilation can satisfactorily assume the function of the patient's breathing mechanisms in most situations. Such ventilation can be administered by mouth-to-mouth techniques, manual methods, or automatic devices. The purpose of this report is to discuss the physiological parameters governing the design of automatic respirators and to review the design of those currently in use. Author

N65-19423# CBS Lab., Stamford, Conn.
PERSONNEL COMMUNICATIONS IN SPACE. A STUDY OF SPEECH TRANSMISSION AND HELMET COMFORT
Technical Documentary Report, Jul.–Sep. 30, 1964
Benjamin B. Bauer, Alfred L. Di Mattia, and Allan J. Rosenheck Wright-Patterson AFB, Ohio, AF Avionics Lab., Dec. 1964 18 p
(Contract AF 33(657)-10737)
(CLD-1720; AL-TDR-64-175, Suppl. 1; AD-609804)

Two research model helmets were developed that possess good communication capability and increased comfort tolerance. The important features of the helmets are described, along with the development of a simple air supply system for the helmets, which permits their being worn for moderate lengths of time for testing and evaluation of communications and comfort tolerance. Author

N65-19461# California Univ., Livermore. Lawrence Radiation Lab. Bio-Medical Research Div.
MAGNETIC FIELDS, VAGAL INHIBITION, AND ACETYLCHOLINESTERASE ACTIVITY
Wei Young and John W. Gofman Feb. 1965 19 p refs
(Contract W-7405-ENG-48)
(UCRL-12389)

The application of a nonuniform magnetic field (4000 to 15000 Oe) produces several effects upon the isolated frog vagal heart preparation, including a consistent decrease in the duration of vagal inhibition, a decrease in cardiac contractility and cardiac work per cycle, and a high frequency of cardiac irregularity arising after cessation of the field. The decreased duration of vagal inhibition is interpreted as an increased rate of acetylcholine hydrolysis. Whatever the mechanism(s) involved, the magnetic field further decreases the vagal inhibition period even after a marked decrease has already been produced by partial replacement of potassium ions by cesium ions in the bathing fluid medium. The data are consistent with, but do not prove, the concept that the magnetic field provokes a major increase in catalytic activity of the enzyme, acetylcholinesterase, at the myoneural junction. Author

N65-19472# Joint Publications Research Service, Washington, D. C.
RADIOSENSITIVITY OF THE LYMPHOCYTES OF THE PERIPHERAL BLOOD IN VITRO OF ANIMALS OF VARIOUS GENOTYPES
N. I. Nuzhdin and N. N. Kuznetsova 25 Mar. 1965 8 p refs
Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 159, no. 4, 1964 p 923–925
(JPRS-29,282; TT-65-30586) CFSTI: $1.00

In an effort to establish a criterion that would characterize the radiosensitivity of animals without actually irradiating them, the in vitro sensitivity of the lymphocytes from animals of various genotypes was determined and compared with the LD_{50} of these animals. Radiosensitivity of the lymphocytes was found to decrease in the following order: rabbit > man > rat > mouse > guinea pig. No significant dependence of lymphocyte radiosensitivity upon sex was observed. The radiosensitivity of the lymphocytes of the animals did not coincide with their ranking by LD_{50}, suggesting that the degree of manifestation of many radiation reactions is not connected with the general radioresistance of the animals. M.P.G.

N65-19521# California Univ., Los Angeles. Human Communication Lab.
LATERALIZATION OF SOUNDS AT THE UNSTIMULATED EAR OPPOSITE TO A NOISE-ADAPTED EAR
Edward C. Carterette, Morton P. Friedmann, William Lindner (Indiana Univ.), and Jean Pierce (Grinnell Coll.) 1 Oct. 1964 21 p refs
(Contract Nonr-233(58); Grants NSF G-21722; PHS MH-07809)
(TR-24; AD-609456)

Some experiments aimed at clearing up disparated results in work on auditory adaptation led to the search and discovery of conditions of monaural stimulation under which a sound image could be located toward the contralateral, unstimulated ear. The phenomenon helps to clarify divergent experimental results. A tentative model, with testable psychophysiological consequences, is outlined. Author

N65-19645# Joint Publications Research Service, Washington, D. C.
SPACE FLIGHT PHYSIOLOGY
V. V. Parin et al 17 Mar. 1965 27 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 1, 1965 p 3–22
(JPRS-29156; TT-65-30527) CFSTI: $2.00

CONTENTS:

1. EFFECT OF IONIZING RADIATION AND SPACE FLIGHT ON SEROTONIN CONCENTRATION IN ANIMAL BLOOD V. V. Parin, V. V. Antipov, M. O. Raushenbakh, P. P. Saksonov, V. S. Shashkov et al p 1–10 refs
2. MECHANISMS OF THE PHYSIOLOGICAL EFFECT OF WEIGHTLESSNESS ON THE HUMAN BODY p 11–20 refs
3. SOME VASCULAR REACTION IN MAN RELATED TO CORIOLIS ACCELERATION R. A. Vartbaronov p 21–26 refs

N65-19646# Sandia Corp., Albuquerque, N. Mex.
PRELIMINARY REPORT ON MICROBIOLOGICAL STUDIES IN A LAMINAR DOWN-FLOW CLEAN ROOM
V. E. Arnold, A. J. Jack, J. G. King, R. C. Marsh, and W. J. Whitfield Jan. 1965 27 p refs
(SC-RR-65-47)

In the original tests performed in the clean room, no bacteria or fungi spores were introduced as test organism. Only those organisms were used which were naturally present in the atmosphere and those which were inadvertently introduced by personnel performing the tests. In the confirmation study, tracer bacteria were introduced in one series as additional proof. Based on the results of the experiments reported here, it can be stated conclusively that the laminar downflow clean room—using filtration and airflow control alone—can control airborne bacteria and fungi as successfully as it can airborne dust and droplets. Author

N65-19655# California Univ., Berkeley. Sanitary Engineering Research Lab.
NUTRITIONAL AND DISEASE TRANSMITTING POTENTIAL OF SEWAGE-GROWN ALGAE First Progress Report, 1 Nov. 1961–1 Aug. 1964
W. J. Oswald, C. G. Golueke, R. C. Cooper, J. H. Meyers, H. Hintz et al Oct. 1964 99 p refs
(SERL-64-6)

Design and use of a pond in a study of reclaiming organic matter and water through culture of algae in waste waters is reported in detail. The pond covers two-thirds of an acre and is equipped with mixer pumps to maintain a culture 2 to 16 inches deep. Centrifuges, sumps, and dryer drums were installed for algae dewatering and harvesting. The pond has been in operation since 1961. Results are reported on performance of the pond, the presence of various bacteria in the equipment and algae, the difficulties in harvesting, the protein assay of harvested product, and algae feeding of sheep and swine. J.M.D.

N65-19664# Joint Publications Research Service, Washington, D. C.
TRANSLATIONS ON HYGIENE AND SANITATION
22 Mar. 1965 20 p refs Transl. into ENGLISH of 4 articles from Gigiena i Sanit. (Moscow), no. 1, Jan. 1965 p 44–47, 51–58, 71–72
(JPRS-29216; TT-65-30554) CFSTI: $1.00

CONTENTS:

1. EXPERIENCE IN CREATING A COMPLEX OF ACOUSTIC CONDITIONS FOR STUDY OF THE EFFECT OF INDUSTRIAL NOISES ON A HUMAN ORGANISM Ye. Ts. Andreyeva-Galanina, S. V. Alekseyev, and G. A. Suvorov p 1–6

2. PROTECTION OF THE ATMOSPHERIC AIR AS ONE OF THE MAIN PROBLEMS OF HYGIENIC SCIENCE AND SANITARY PRACTICE P. P. Lyarskiy and M. K. Nedogibchenko p 7–12

3. FORMS AND METHODS OF WORK PERFORMED BY RADIOLOGICAL GROUPS OF SANITARY EPIDEMIOLOGICAL STATIONS M. A. Sobolevskiy p 13–17

4. AN INCIDENCE OF MERCURY VAPOR CONTAMINATION OF RESIDENTIAL BLOCKS I. D. Krupitskaya and I. L. Pisarevskiy p 18–20

N65-19665# Joint Publications Research Service, Washington, D. C.

RADIATION INJURIES AND RESTORATIVE PROCESSES IN THE CENTRAL NERVOUS SYSTEMS

A. A. Manina 25 Mar. 1965 8 p Transl. into ENGLISH from the book "Luchevyye Porasheniya i Vosstanovitel'nyye Protsessy v Tsentral'noy Nervnoy Sisteme" Leningrad, 1964 p 204–209, 226–227

(JPRS-29288; TT-65-30589) CFSTI: $1.00

A translation is presented of the conclusion and the table of contents of the cited book. Intrauterine irradiation of rat embryos on the tenth day of embryogenesis is discussed. Dosages ranged from 300 R down to 50 R, and the effects ranged from embryonic death in 4 to 5 days down to moderate hydrocephalus. The table of contents lists chapters covering the normal development of the central nervous system of the rat, the effect of ionizing radiation on the development of the central nervous system of some mammals, the effect of external irradiation of the central nervous system of adult animals, and the effect of internal beta-radiation from $_{32}P$ on the central nervous sytem of rats in various periods of its maturation. D.E.W.

N65-19676# Northrop Space Labs., Hawthorne, Calif.

ANALYSIS AND BIODYNAMICS OF SELECTED ROCKET-SLED EXPERIMENTS

Brooks AFB, Tex., School of Aerospace Med., Jul. 1964 328 p

(Contract AF 41(609)-2317)

(AD-609412)

CONTENTS:

1. BIODYNAMICS OF MAXIMAL DECELERATIONS J. P. Stapp, J. D. Mosely, C. F. Lombard, and G. A. Nelson 161 p refs (See N65-19677 09-04)

2. DYNAMIC RESPONSE OF RESTRAINED SUBJECT DURING ABRUPT DECELERATION G. Nichols 157 p (See N65-19678 09-04)

N65-19677 Northrop Space Labs., Hawthorne, Calif.

BIODYNAMICS OF MAXIMAL DECELERATIONS

J. P. Stapp, J. D. Mosely, C. F. Lombard, and G. A. Nelson *In its* Analysis and Biodynamics of Selected Rocket-Sled Expts. Jul. 1964 161 p refs (See N65-19676 09-04)

The methods and procedures used to expose adult anesthetized chimpanzee subjects to high levels of deceleration during 23 experiments on the rocket sled are presented. Deceleration was accomplished by programed water inertia braking where trapezoidal patterns were produced. Onsets of deceleration ranged from 450 to 36 000 g per second with plateau levels ranging from 33 to 107 g with duration from 87 to 527 msec. The test sled was accelerated by rockets at a maximum of 7 g up to a maximum velocity of 1194 ft per sec. These experiments show the injurious effects of exposure to acceleration ($-g_x$) correlated with the rate of onset of -g, the peak level of g, and the progressive improvement of the restraint system. One subject exposed to a maximal (96 g at 8500 g/sec onset) $+g_x$ sustained no persistant injury. All the other exposures were $-g_x$. Survival limits of the test subjects are roughly four times the known tolerance limits of human volunteers. The results are presented of a study made to determine the relationship of the many variables involved when a restrained subject is exposed to an abrupt deceleration by the application of a basic forcing function to the supporting vehicle. The studies include the response of the restraints under both static and dynamic loads. Author

N65-19678 Northrop Space Labs., Hawthorne, Calif.

DYNAMIC RESPONSE OF RESTRAINED SUBJECT DURING ABRUPT DECELERATION

G. Nichols *In its* Analysis and Biodynamics of Selected Rocket-Sled Expts. Jul. 1964 157 p (See N65-19676 09-04)

Study of abrupt deceleration of human subject restrained by straps to the decelerating structure is presented. The decelerative forces were similar to crash conditions, and were applied in rectangular, triangular, trapezoidal, and sinusoidal patterns; the straps were of waist, shoulder, and harness designs. The main factors in the experimentation were varied deceleration rates and levels, subject mass and position, and degree of strap stiffness and energy-absorbing capacity. Observations in linear and nonlinear restraint tests were of maximum subject force, rate of buildup, and displacement. It was found, in general, that slack restraint is hazardous. J.M.D.

N65-19692*# Naval School of Aviation Medicine, Pensacola, Fla.

THE ULTRASTRUCTURE OF THE OTOLITH ORGANS IN SQUIRREL MONKEYS AFTER EXPOSURE TO HIGH LEVELS OF GRAVITOINERTIAL FORCE Research Report No. 102

Heinrich H. Spoendlin, Harold F. Schuknecht, and Ashton Graybiel 5 Nov. 1964 26 p refs Joint Rept. with NASA

(NASA Order R-93)

(NASA-CR-57274)

Eleven squirrel monkeys were exposed to gravitoinertial force of either 5.43 or 10.92 G units for periods up to 10 minutes in different body (head) positions. Three animals died. Gross examination of the brains revealed no pathological changes. The ultrastructure of the maculae, as revealed by electronmicroscopy, was not altered in any of the animals exposed to high G stress. A detailed account of the findings in these and normal control animals is given and includes some new observations. If the G loadings in this experiment are not exceeded orbital space flights, alterations of the macula would be ascribable to other causes including the prolonged deafferentation associated with weightlessness. Author

N65-19746*# Naval School of Aviation Medicine, Pensacola, Fla.

COMPARATIVE HISTOLOGICAL STUDY OF THE REINFORCED AREA OF THE SACCULAR MEMBRANE IN MAMMALS

Makoto Igarashi 14 Oct. 1964 17 p refs Joint rept. with NASA

(NASA Order R-93)

(NASA-CR-60389; BuMeD-101) CFSTI: HC $1.00/MF $0.50

The reinforced area of the saccular membrane was microscopically investigated in 65 mammalian inner ears, including those of man. A definite reinforced area existed in all of the

human ears examined as well as in the ears of the squirrel monkeys; however, in the latter case some of the areas were narrow or of questionable formation. The four-legged mammalian ears studied showed no reinforced area, with exception of those of the flying squirrel. It is possible that, as a stimulus receptor, the function of the saccule in primates differs from that of the saccule in lower mammals. Author

N65-19784# Library of Congress, Washington, D. C. Aerospace Technology Div.
HIGH-ALTITUDE PRESSURE SUITS AND HERMETICALLY SEALED CABINS FOR STRATOSPHERIC FLIGHTS [VYSOTNYYE SKAFANDRY I GERMETICHESKIYE KABINY DLYA STRATOSFERNOY AVIATSII]
V. A. Spasskiy 16 Mar. 1965 17 p Transl. into ENGLISH from Vestn. Vozdushnogo Flota (USSR), no. 5, 1938 p 48–59
(ATD-P-65-13) CFSTI: HC $1.00/MF $0.50

Various problems of high-altitude flights are considered in the development and application of hermetically sealed cabins and stratospheric space suits, to guarantee the necessary conditions for the preservation of life and the working capacity of the crew. The basic problems for hermetically sealed cabins are the maintenance of normal breathing conditions for the crew, protection against cold, and provision of good visibility. The use of space suits for testing of high-altitude aircraft, during flights of multiseat bombers, and in single seater fighters is outlined. The basic problems in designing pressure suits are freedom of movement, regulation of the necessary inside pressure, protection of the flier against cold, and provisions for everyday comfort. It is concluded that the fight for new aircraft ceilings and velocity expansion depends to a certain extent on the success of hermetically sealed body environments. G.G.

N65-19785# Library of Congress, Washington, D. C. Aerospace Technology Div.
SOVIET BIOASTRONAUTICS AND MANNED SPACEFLIGHT: PROGRAMS, ORGANIZATION, AND PERSONALITIES
18 Mar. 1965 123 p refs
(ATD-P-65-14) CFSTI: HC $4.00/MF $1.00

Information on bioastronautics and manned space flight programs obtained from Soviet publications through the middle of 1964, is presented. Topics include: *Table of Biomedical Spaceflights; Experiments in Space*—animal and plant studies; *Space Microbiology; Exobiology; Space-Oriented Radiobiology; Weightlessness; Acceleration; Gas Environment and Respiratory Problems; Chlorella and Higher Plants; Food for Spaceflight; Life Support Systems; Human Engineering; Biotelemetry;* and *Selection and Training*. A list of active bioastronautic scientific and research organizations, and the names of scientists associated with these organizations are included. G.G.

N65-19810# Joint Publications Research Service, Washington, D. C.
FEATURES OF HOMEOSTATIC REACTION DURING HYPOXIC HYPOXIA IN DOGS AT THEIR VARIOUS AGES
I. S. Ugolbayeva 26 Feb. 1965 10 p refs Transl. into ENGLISH from Byull. Eksptl. Biol. i Med. (Moscow), v. 58, no. 9, Sep. 1964 p 34–38
(JPRS-28921; TT-65-30400) CFSTI: $1.00

Two series of experiments were performed on 80 dogs of various ages (without anesthesia) to determine their resistance to hypoxia. The criterion of resistance was their ability to maintain homeostasis for a prolonged period of time as determined from the activity of the cardiovascular, respiratory, and thermoregulating system. The first series of experiments exposed the dogs gradually to simulated altitudes of 2000 to 6000 meters and kept them at the maximum height for 30 min to 2 hours; in the second series of experiments the animals were elevated rapidly from 7000 to 16 000 meters. Young puppies up to 18 days old were much less resistant to reduced atmospheric pressure than adult dogs, due to their lack of the bradycardiac phase. It is concluded that the difference in lethal altitudes and exposures as a function of age should be defined as a difference in endurance limits. G.G.

N65-19822# Bureau of Commercial Fisheries, Ann Arbor, Mich.
IRRADIATION PRESERVATION OF FRESH-WATER FISH AND INLAND FRUITS AND VEGETABLES
J. A. Emerson, N. Kazanas, R. A. Grieg, H. L. Seagran, P. Markakis (Mich. State Univ., Lansing) et al Oak Ridge, Tenn., AEC, Aug. 1964 94 p refs Prepared Jointly with Mich. State Univ., Lansing and Mich. Univ.
(Contract AT(11-1)-1283)
(COO-1283-12) CFSTI: $3.00

The potential value of irradiation pasteurization as a processing method for extending the refrigerated shelf-life of inland fruits, vegetables, and fish is studied. It appears that irradiation pasteurization can significantly extend refrigerated storage life for a given period of time. Among the specific foods mentioned are potatoes—5 krad of gamma irradiation can prevent sprouting of Arenac potatoes for at least 6 weeks; strawberries—mold appearance can be delayed by 4 to 8 days with 200 krad of either gamma or 0.6 MeV electron irradiation; and fish—yellow perch irradiated at 0.0, 0.2, or 0.5 Mr and held at 36° F are quite acceptable organoleptically after 3 weeks of storage. R.W.H.

N65-19833# Deutsche Versuchsanstalt für Luft- und Raumfahrt, Bad Godesberg (West Germany). Institut für Flugmedizin
THE BIOLOGICAL EFFECT OF PROGRESSIVELY APPLIED HIGH PRESSURE. PRESENTATION NO. 1 [DIE BIOLOGISCHE WIRKUNGHOHER STOSSFREIER DRUCKBELASTUNG. I. MITTEILUNG]
O. Wünsche Saint Louis, France, Inst. Franco-Allemand de Rech., 1964 25 p refs
(ISL-2/64)

Albino rats underwent steadily increasing dynamic pressure in a pressure chamber up to 46 atm of 0.5- to 0.6-seconds duration and decompression of about 14 seconds after constant pressure level of 2 to 40 seconds. The duration of exposure at maximal atmospheric pressure was found to be essential for the biological tolerance criterium. Static pressures up to 37 atm with short exposure duration followed by 5- to 6-minutes decompression time did not produce any ill effects and even higher pressures were tolerated when pressure increase and decrease were suited to the mechanical breathing conditions. Animals exposed to maximal pressures of prolonged duration showed massive gas bubbles in their venous system at exitus. Transl. by G.G.

N65-19834# Space Technology Labs., Inc., Redondo Beach, Calif. STL Technical Library
EXOBIOLOGY: A BIBLIOGRAPHY Research Bibliography No. 52, 1955–Jun. 1964
L. R. Magnolia, S. A. Gogin, and J. A. Turley Oct. 1964 170 p refs
(STL-9990-6737-KU-000; AD-449959)

This bibliography consists of 400 annotated references on the existence and detection of life outside the earth's biosphere, the origin of life, studies of metecritic "life," and contamination problems. The majority of the items are those published during the period 1955 to June 1964. The abstracts are primarily those written by the individual authors. Author

N65-19871*# Ohio State Univ. Research Foundation, Columbus. Environmental Physiology Lab.

BIOLOGICAL EFFECTS OF PROLONGED EXPOSURE OF SMALL ANIMALS TO UNUSUAL GASEOUS ENVIRONMENTS Semiannual Report, 1 Sep. 1964–28 Feb. 1965

H. S. Weiss and R. A. Wright 1 Mar. 1965 18 p refs *Its* Rept.-1492-5

(Grant NsG-295-62)

(NASA-CR-57477) CFSTI: HC $1.00/MF $0.50

Groups of mice exposed to a 100% O_2 atmosphere under varying pressures, and with interruptions for periods of air breathing, were found to withstand oxygen toxicity better, due to the reduced oxygen tension in the respired atmosphere. White Leghorn chickens were able to withstand O_2 toxicity of a 100% O_2 atmosphere at atmospheric pressure for as long as two weeks. A method to extract lipids from the rat lung by saline perfusion after exposure to 1 atmosphere O_2 is described; this resulted in an extract containing sphyngomylin, lecithin, and cephalin. Wistar rats maintained in a 79% He–21% O_2 atmosphere for 24 days did not show changes in urine volume or water consumption but food intake was increased. Chickens and rats exposed to a 79% He–21% O_2 environment were found to be sensitized to N_2 leading to a metabolic depression upon transfer to air. Ten hatching trials of chicken eggs incubated in He–O_2 atmosphere resulted in only two normal hatches. Body heat loss tests of men on a bicycle ergometer in a 79% He–21% O_2 atmosphere at 95° F and in varying humidity levels were inconclusive, due to the difficulty of keeping temperature and humidity at the desired level. G.G.

N65-19947*# National Aeronautics and Space Administration, Washington, D. C.

MEDICAL ASPECTS OF SPACE FLIGHT

Frank E. Voris [1964] 19 p

(EP-17) GPO: HC $0.15; CFSTI: MF $0.50

The major human research problems of the manned space environment are presented. These are respiratory requirements, acceleration forces, weightlessness, radiation hazards, nutrition, waste collection, waste disposal, hazards of strike and penetration of the space ship by meteoroids, and psychological problems. The requirement for miniaturization of psychophysiological monitoring has greatly accelerated medical technology. The biotechnology, required to develop life support systems for space, results in better equipment for miners, for underwater workers, and for persons who must handle dangerous materials or be in hazardous areas. Many direct and indirect benefits will result from our national technical advancements. E.E.B.

N65-19962*# Brandeis Univ., Waltham, Mass. Dept. of Biochemistry

THE EFFECT OF TETRATHIONATE ON THE STABILITY AND IMMUNOLOGICAL PROPERTIES OF MUSCLE TRIOSEPHOSPHATE DEHYDROGENASES

William S. Allison and Nathan O. Kaplan [1964] 47 p refs Submitted for Publication

(Grant NsG-375)

(NASA-CR-56251) CFSTI: HC $2.00/MF $0.50

When three sulfhydryl groups of rabbit, turkey, sturgeon, and lobster triosephosphate dehydrogenases (TPD's), are modified by tetrathionate, the enzymes are completely inhibited. This inhibition can be reversed by the addition of thiols. Losses in immunological activity with specific rabbit antisera prepared against the active forms of the enzymes are observed when the turkey, sturgeon, and lobster TPD's are reversibly and irreversibly inactivated with tetrathionate. The immunological properties of the sturgeon enzyme are only slightly altered when inactivated with tetrathionate, while the immunological properties of the tetrathionate inactivated turkey and lobster TPD's differ significantly from the native enzymes. All of the TPD's studied appear to have no disulfide linkages, since all of the nonmethionine sulfur exists as sulfhydryl groups. It is concluded that the active conformations of the different TPD's are partly stabilized by the three active sulfhydryl groups which react with tetrathionate, but the degree of stabilization varies with the different enzymes. Author

N65-19970# Aerospace Medical Div. Arctic Aeromedical Lab., Fort Wainwright, Alaska.

REVIEW OF RESEARCH ON MILITARY PROBLEMS IN COLD REGIONS

Charles R. Kolb and Fritz M. G. Holmstrom, F. Med. Dec. 1964 170 p refs Presented at 15th Alaskan Sci. Conf., Am Assoc. for the Advan. of Sci., College, Alaska, 31 Aug.–4 Sep. 1964

(AAL-TDR-64-28; AD-457733)

Papers in this symposium pertain to (1) Alaskan physical environment, military construction, and water supply problems, (2) polar region long-distance radio communications, materials engineering and brittle fracture, and traffic possibilities in snow and muskeg, and (3) human safety, clothing, and the effects of isolation in polar regions. J.M.D.

N65-20018# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT THE ONES WHO REMAIN ON EARTH

O. Gazenko 1 Mar. 1965 16 p Transl. into ENGLISH from Nauka i Zhizn (Moscow), no. 1, 1964 p 26–31

(FTD-TT-64-920/1+2; AD-611860)

The history of aviation medicine as the forerunner of space medicine is sketched. It is pointed out that experiments on animals and investigations with the participation of people have prepared for the flight of the cosmonauts. Therefore, in paying tribute to the cosmonauts, the great contribution by the large group of laborers, engineers, technicians, and scientists, who created aircraft, then the space ships, and developed the technology so responsible for the flights, should not be forgotten. E.E.B.

N65-20024# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SELF-CONTAINED METHODS OF ANTI-RADIATION AND ANTI-CHEMICAL PROTECTION

J. A. Alkhazov and A. P. Tkachev 15 Feb. 1965 70 p refs Transl. into ENGLISH of the book "Individual'nye Sredstva Protivoradiatsionnoyi Protivokhimicheskoy Zashchity" Moscow, Gos. Izd. Lit. po At. Nauke i Tekhn. Gosi Komiteta po Ispol'z. At. Energ. SSSR, 1963 p 1–61

(FTD-TT-64-998/1+2; AD-611745)

Various devices and materials are discussed that can aid in protecting against chemical and radiation hazards. The protectives are described, and methods and rules for their use are discussed. This book was intended as a teaching aid in the training of personnel of civil defense units. D.E.W.

N65-20095# Joint Publications Research Service, Washington, D. C.

MEDICAL AND PSYCHOLOGICAL PROBLEMS IN LONG SPACE FLIGHTS

V. Andreyev 22 Mar. 1965 8 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 3 Dec. 1964 p 3

(JPRS-29211; TT-65-30551) CFSTI: $1.00

The creation of artificial gravity in the spaceship to protect the crew against adynamia induced by prolonged weightlessness in long duration space flights is proposed. Employment of the crew members with mental labor during part of the time would prevent disruption of the mental processes caused by the homogeneity and monotony of impressions during

flights in a closed cabin. Radio and television can play a role in eliminating sensory starvation. G.G.

N65-20099# Joint Publications Research Service, Washington, D. C.
MECHANISMS OF TROPHIC EFFECTS
A. K. Podshibyakin 26 Mar. 1965 15 p Transl. into ENGLISH from the pamphlet "O Troficheskoy Funktsii Nervnoy Sistemy" Kiev, Acad. of Sci. Ukr. SSR, 1964 p 40–53
(JPRS-29303; TT-65-30593) CFSTI: $1.00

It is argued that the trophic function of the nervous system in the organism of animals and man which regulates the biochemical and biophysical bases of life, ensures the existence of complicated complexes of proteinic bodies, their structures, and their harmonious activity. Also, the trophic function ensures optimum development of activity, regulates the intake, assimilation and expenditure of energy producing substances on behalf of the working organ and the entire organism, and conditions the resistance of organs and tissues to different harmfully acting agents of the external and internal environment. The trophic effect is revealed most clearly with irritations of definite strength and quality, with the use of adequate chemical agents, and with a special condition of the organ. Arguments to support these conclusions are taken from the research of many workers over a considerable period of time. E.E.B.

N65-20100# Joint Publications Research Service, Washington, D. C.
REGULATION OF VITAL FUNCTIONS AND CYBERNETICS
N. M. Amoxov 29 Mar. 1965 94 p Transl. into ENGLISH of the book "Regulyatsiya Zhizhennykh Funktsiy i Kibernetika" Kiev, 1964 p 2–115
(JPRS-29330; TT-65-30607) CFSTI: $3.00

A new view of the organism as a complex system which is dominated by the same laws of control and communications that apply to technical systems is provided by cybernetics. Also, cybernetics offers a new approach to an experiment, the essence of which consists of obtaining a maximum quantity of information with the aid of numerous electronic devices and of the subsequent processing of the results on computers. Cybernetics methods are available to institutions consisting of medical personnel, biologists, mathematicians, and engineers. Such institutes must be equipped with electronic, chemical, and computer apparatus. The benefits of cybernetics to medicine and to mankind are developed. E.E.B.

N65-20121# Washington Univ., Seattle.
ON THE TRANSFER FUNCTION OF HUMAN SKIN Final Report
Konrad J. K. Buettner 1965 27 p refs
(Contract DA-18-108-405-CML-666)
(AD-611281)

Water and water vapor are believed to move through intact skin surface by glandular secretion such as that of sweat glands, sorption and desorption in the horny layer, and diffusion through the horny layer. Sweating can be partly controlled by low room temperature, atropine, and selection of a body area not prone to sweating. Horny layer sorption and desorption is a saturation process after the skin enters a new environment. After sweat and sorption are evaluated or prevented, there remains a flow of liquid water or vapor through the skin. In the diffusion of skin water exchange the active process or pump seems to be separated from the environment by a barrier which appears to be the part or the whole of the stratum corneum conjunction. R.W.H.

05 BIOTECHNOLOGY

Includes life support systems, human engineering, crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N65-18678# Dunlap and Associates, Inc., Darien, Conn.
HUMAN FACTORS STUDY OF THE USN MARK II HAND HELP SEXTANT Final Report
Nov. 1964 32 p refs
(Contract N140(62462)-76732B)
(DRD-64-133; AD-609048)

Based on available data and laboratory experiments, the following recommendations were made: (1) a double line configuration for the artificial horizon, (2) the use of an astigmatizing lens for accurately determining tangency as well as for facilitating altitude measurement, (3) intensity of the horizon at the same level as that of the body being observed, (4) improvement of readout scales, (5) provision of illumination, (6) neutral polarizing filters for viewing the body, (7) amber and red filters for viewing the horizon, (8) specific control characteristics, (9) a 6 × 30 monocular telescope for the optimum tradeoff among variables, (10) a large rubber eyecup to provide additional steadiness, (11) a human engineered handle for increased steadiness and comfort, and (12) an upper limit of 4 pounds. R.L.K.

N65-18784# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH IN BIOASTRONAUTICS
10 Mar. 1965 31 p Transl. into ENGLISH of Articles from Aviats. i Kosmonavt. (Moscow), no. 11, Nov. 1964 p 24–36
(JPRS-29069; TT-65-30486) CFSTI: $2.00

CONTENTS:

1. GROUNDWORK FOR NEW JOURNEYS INTO OUTER SPACE: A UNIQUE EXPERIMENT BY SOVIET SCIENTISTS. 120 DAYS IN A PRESSURIZED CHAMBER p 1–14 (See N65-18785 09-05)
2. NEEDED: A THEORY OF WEIGHTLESSNESS p 15–19 (See N65-18786 09-05)
3. MEDICOBIOLOGICAL SUPPORT OF PROLONGED SPACE FLIGHT p 20–26 (See N65-18787 09-05)

N65-18785 Joint Publications Research Service, Washington, D. C.
GROUNDWORK FOR NEW JOURNEYS INTO OUTER SPACE: A UNIQUE EXPERIMENT BY SOVIET SCIENTISTS. 120 DAYS IN A PRESSURIZED CHAMBER
In its Soviet Res. in Bioastronautics 10 Mar. 1965 p 1–14
(See N65-18784 09-05) CFSTI: $2.00

Experiments are reported in which human subjects were hermetically sealed for varying periods of time in a chamber simulating a space cabin. Major areas of investigation included changes in the subjects' immunoreactivity, changes in the composition of the enclosed atmosphere such as increased carbon monoxide and dioxide, and measurable physiological, behavioral, and performance changes in the subjects. D.E.W.

N65-18786 Joint Publications Research Service, Washington, D. C.
NEEDED: A THEORY OF WEIGHTLESSNESS
In its Soviet Res. in Bioastronautics 10 Mar. 1965 p 15–19
(See N65-18784 09-05) CFSTI: $2.00

Consideration is given to various aspects of weightlessness, with emphasis on its effects on men in this condition for extended periods. The threshold of sensitivity to gravity was studied in relation to length of time in weightlessness. Other areas of study included accuracy of movement, bioelectric activity, reduced tendency to nystagmus, gaseous metabolism, and energy expenditures. D.E.W.

N65-18787 Joint Publications Research Service, Washington, D. C.
MEDICOBIOLOGICAL SUPPORT OF PROLONGED SPACE FLIGHT
In its Soviet Res. in Bioastronautics 10 Mar. 1965 p 20-26 (See N65-18784 09-05) CFSTI: $2.00

Flights to the moon and other astronomical bodies are contemplated, and the increased activity of the support program is discussed. In particular, the stronger role of medical and biological support in the overall program is considered. The analysis of handwriting to detect systemic disturbances during acceleration, normal gravity, or weightlessness is discussed, and a physiological measuring system for installation in a spacecraft is described. D.E.W.

N65-18852# Boeing Co., Wichita, Kans.
VISUAL-MOTOR PERFORMANCE DURING WHOLE-BODY VIBRATION Technical Report No. 5
R. E. Chaney and D. L. Parks Nov. 1964 88 p
(Contract Nonr-2994(00))
(D3-3512-5; AD-456271)

Seven male employees were tested in the company's human vibration facility to determine the effect of whole body vibration on visual-motor performance. Six controls, a large and a small knob, a horizontal and a vertical lever, and a horizontal and a vertical thumbwheel were used to adjust a standard 3-inch dial indicator to a prescribed setting. Independent variables included variations in vibration frequency and severity, control force requirements, and task complexity. Speed and accuracy of task accomplishment were recorded for each condition. A high workload condition, vibration independent of frequency and level, and control force requirements individually affected the speed and accuracy of operator adjustment. The type of control used did not influence accuracy, and had only minor influence on adjustment time with mounting position apparently producing the noted differences. Author

N65-18853# Boeing Co., Wichita, Kans.
TRACKING PERFORMANCE DURING WHOLE-BODY VIBRATION Technical Report No. 6
R. E. Chaney and D. L. Parks Nov. 1964 40 p refs
(Contract Nonr-2994(00))
(D3-3512-6; AD-456277)

Seven male volunteers were tested to determine the effect of whole body vertical vibration on tracking performance. Compensatory wheel, column, and foot tracking data were obtained at each of 4 subjective reaction levels at frequencies ranging from 1 through 27 cycles/second. A perfect correlation between subjective vibration experience and tracking performance degradation was noted. The largest degree of error was produced in the 10- through 20-cps range with vibration severity (reaction level) differentially affecting the critical frequencies. Foot tracking performance improved as control forces were increased, with less improvement shown under vibration than the nonvibrating control condition. Author

N65-18876# Naval Medical Research Lab., New London, Conn.
PREDICTION OF ADJUSTMENT TO PROLONGED SUBMERGENCE ABOARD A FLEET BALLISTIC MISSILE SUBMARINE. IV: PSYCHOPHYSIOLOGICAL INDICES
Benjamin B. Weybrew 24 Nov. 1964 36 p refs *Its* Vol. 22, No. 18
(Rept.-416; AD-449530)

Fourteen psychophysiological indices of response to hyperventilation and breathholding and to discrimination-conflict stress were combined with measures of neuroticism, motivation, and aptitude to form a correlation matrix including adjustment ratings obtained from 200 men during 2 successive cruises aboard a nuclear submarine. Patterns of psychophysiological indicators with adjustment criteria were identified by factor variables resulted in Multiple R's ranging from 0.40 to 0.62. For the purpose of communication, these factors were labeled limited adjustment potential, optimal adjustment potential resiliency, autonomic feedback, and stress responsivity. The structure of the factors suggested somatopsychological dimensions of use in personality assessment especially when selection of men for hazardous duty is involved. Author

N65-18877# Naval Medical Research Lab., New London, Conn.
A REVIEW OF THE RATIONALE OF THE VISUAL STANDARDS FOR SUBMARINE DUTY
Paul R. Kent 19 May 1964 19 p refs *Its* Vol. 23, No. 10
(Rept.-428; AD-449500)

The visual capabilities of a person just meeting the present minimum visual acuity standard for submarine duty were analyzed and matched with the visual tasks normally found on submarines. Assuming that the standards are based upon unaided visual capabilities, it was found, that in general, the current visual standards are reasonable. It was found possible to modify the visual standard in such a manner, however, that more candidates would pass the visual test, and by analysis, these were found to have binocular visual capabilities at least equal to those minimally acceptable under the current standard. Author

N65-18929# California Univ., Los Angeles. Biotechnology Lab.
UPPER EXTREMITY PROSTHETICS RESEARCH, HUMAN TRACKING, SENSORY MOTOR CONTROL, AND MYOELECTRIC CONTROL STUDIES Progress Report
John Lyman 15 Mar. 1964 44 p ref
(Contracts N123(60530)23558A; VA-V1005M-2075; Grant VRA-RD-1201M-64)
(Rept.-64-30; AD-605204)

A needs analysis for the development of externally powered prostheses design specifications is discussed. The current statuses are given for experimental investigations of the Heidelberg pneumatic arm and of the Northwestern University electric elbow. An evaluation of the Optiscan head-mounted eye-movement camera for prosthetic motor-skills evaluations showed several serious deficiencies involving camera focusing, the ground glass, parallax, exposure, and overall design of the instrument. Work is reported on the AIPR arm, on transducer development, and on functional muscle isolation. Two aspects of work on the performance of human operators of tracking systems are discussed, including a performance evaluation of variables of the optical system on a particular tracking simulator, and a human operator tracking study with a serially arranged two-man team. D.E.W.

N65-18938*# Florida State Univ., Tallahassee. Dept. of Psychology
PERIPHERAL MECHANISMS OF HUMAN TEMPERATURE SENSITIVITY Final Report, 1 Sep. 1961–31 Aug. 1964
D. R. Kenshalo [1964] 14 p refs
(Grant NsG-148-61)
(NASA-CR-57207) CFSTI: HC $1.00/MF $0.50

A thermal stimulator utilizing a Peltier refrigerator as transducer and able to measure skin temperatures to ±0.025° C accurately within the physiological limits, and a modified Peltier refrigerator containing a photoelectric plethysmograph for recording of cutaneous blood vessel volume changes is described. These were employed to measure the intensity of radiant energy necessary to produce a threshold warm sensation as a function of the size of the area of the skin exposed, and showed good agreement between the measurements of the cool threshold and the volume pulse amplitude. Tests indicated no marked sensitivity changes to either warm or cool stimuli for either sex with advanced age. Changes in the cool threshold of female subjects were associated with the estrogen–progesterone level in the ovarian cycle and showed generally more sensitivity to cooling than the male counterparts of the same age group. Females adapted more completely to higher skin temperatures than males. In drug studies, adrenalin iontophoresis into the skin produced vasoconstriction in the area of stimulation and depressed the cool threshold. Experimental investigation of the course of adaptation to thermal stimuli indicated a range of about 29° to 37.5° C for the individual physiological zero values. G.G.

N65-18963# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
FORM PERCEPTION IN VIDEO VIEWING: EFFECTS OF FORM CONTENT AND STEREO ON RECOGNITION Final Report
Larry W. Paine Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1964 38 p refs
(Contract AF 19(628)-328)
(ESD-TDR-64-666; AD-609992)

Recognition values, under varying levels of image degradation, were determined for randomly constructed objects of varying complexity (contour turns) and for familiar geometric objects. Values for both familiar and unfamiliar objects were significantly affected by image degradation, but were unaffected by using stereo viewing as compared with nonstereo viewing. Variations in the effective interobjective distance between stereo images had no significant effect on recognition values. Author

N65-18966# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
FUNCTIONAL FUNDAMENTALS TRAINING FOR ELECTRONIC MAINTENANCE PERSONNEL
John P. Foley, Jr. Nov. 1964 60 p refs
(AMRL-TR-64-85; AD-610367)

Previous experiments concerning functional electronic fundamentals have applied the functional principles to training for a very limited and specific area of maintenance—in some cases to only one electronic equipment. This experiment was designed to include the fundamental tasks and concepts applicable to all of the electronic communications specialties. The course was organized around specially designed trainers that incorporated the desired circuits and task requirements. Considerable well spaced maintenance practice was given using common test equipment such as vacuum-tube voltohmmeter, signal generator, and oscilloscope. The curriculum development principles and procedures as well as the results of controlled experiments are given. The findings indicated that the traditional and experimental courses were equally successful in training high aptitude students. The experimental course was much more successful, however, in training average aptitude students. The job success of the average aptitude graduates was equivalent to that of the higher aptitude graduates. Author

N65-19004# Army Natick Labs., Mass. Pioneering Research Div.
REFERENCE ANTHROPOMETRY OF THE ARCTIC-EQUIPPED SOLDIER
Robert M. White, Theodore R. Zimmerer, and John L. Kobrick Aug. 1964 27 p refs
(EPT-2; AD-449483)

Data are presented on body dimensions for the size range of the Army population dressed in the Army arctic clothing ensemble. The information is presented in tabular form, accompanied by diagrams denoting the exact location of the specified dimensions. Author

N65-19017# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
TRAINING FOR CULTURE-CONTACT AND INTERACTION SKILLS Preliminary Report, Feb. 1963–Aug. 1964
Donald B. Haines Dec. 1964 32 p refs
(AMRL-TR-64-109; AD-611022)

This report outlines a procedure for collecting in the field those cross-cultural behaviors most critical for the success of the advisory mission. A means of categorizing these behaviors for incorporation into a training program is described. Those behaviors requiring passive knowledge may be easily taught by traditional lectures and handbooks. Other behaviors may be taught by programed instructional materials while some require such subtleties of skill and motor facility that they require more elaborate teaching methods. A new method for teaching interaction skills through the use of a video type recorder is also presented. Subjects are placed in a simulated cross-cultural situation requiring interaction skills known to be critical in the advisor–advisee relationship. They learn these skills through self-confrontation with video–aural playback of their behavior. Author

N65-19028# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IN THE DETACHMENT OF ASTRONAUTS
P. S. Denisyuk 4 Dec. 1964 21 p Transl. into ENGLISH from Sov. Kirgiziya (USSR), no. 182–185, 6–9 Aug. 1963 p 4 (of each issue)
(FTD-TT-64-398/1; AD-609924)

The notes of one of the trainers who prepared the cosmonauts for space flight are presented in rough draft translation. Some of the cosmonauts noted are Gagarin, Bykovskiy, Tereshkova, and Popovich. The notes are concerned mainly with the activities, conversations, and relationships of the cosmonauts. D.E.W.

N65-19116# Ohio State Univ., Columbus. Lab. of Aviation Psychology
EXPERIMENTS ON TEAM TRAINING IN A CIC-TYPE TASK ENVIRONMENT
George E. Briggs and James C. Naylor Jun. 1964 39 p refs
(Contract N61339-1327)
(NAVTRADEVCEN-1327-1; AD-608309)

Laboratory experiments on team training in a simulated CIC environment were conducted. Effects of replacement, task

organization and complexity, task fidelity, and amount of experience were investigated. Individual rather than team training is the preferred procedure for tasks requiring interaction among operators. Author

N65-19149# Aerospace Medical Div. Aerospace Medical Research Labs. (6570th), Wright-Patterson AFB, Ohio.
TRACKING PERFORMANCE AS A FUNCTION OF EXPONENTIAL DELAY AND LEARNING Final Report
Marvin Levine, John W. Senders, Ross L. Morgan, and Louise Doxtater Nov. 1964 20 p refs
(AMRL-TR-64-104; AD-609811)

Eighty subjects performed a one-dimensional compensatory tracking task for 55 1-minute trials. The subjects were divided into five separate groups and each group performed the task with a different exponential delay between the control input and the display, a dot of light on a cathode ray tube. The time constants for the exponential delays were 0.015, 0.150, 0.900, 2.100, and 3.000 seconds. The results indicate that time-on-target scores decrease with increasing delay. For delays greater than 0.150 seconds, the decrease is linear. There is a sharper decrease in performance from 0.015 seconds delay to 0.150 seconds delay than for other portions of the function. Increased practice changes the level, but not the shape, of the total function. The effects of delay and learning were within the same range, indicating that a given level of system performance often can be achieved either by altering the delay or by training the operator. However, performance is maximized if delay is reduced and the operator is trained. Author

N65-19150# Pittsburgh Univ., Pa.
AN EVALUATION OF MULTIPLE TRACKS IN A LINEAR PROGRAM Technical Report, Oct. 1961–Oct. 1962
Robert Glaser, James H. Reynolds, Theodore Harakas, A. G. Holzman, and John S. Abma (AMRL) Wright-Patterson AFB, Ohio, AMRL, Oct. 1964 22 p refs
(Contract AF 33(616)-7175)
(AMRL-TR-64-108; AD-609801)

Two experiments were performed to evaluate multitracking (branching) in a linear program. In experiment one, the multitracking consisted of providing additional cues at each frame for use by those students who felt unsure of their response. Results indicated no significant difference in efficiency between the regular linear program and the multitrack program. In experiment two, the multitracking consisted of large frames followed by more detailed frames whenever the student made an error. Large frames were developed by combining an average of three small frames. Again, the results indicated no difference in instructional efficiency between the regular linear program and the multitrack program. Although more errors were made on the large-step branching program, performance on criterion tests was as good as for the regular small-step linear program. Although branching seems a reasonable way to accommodate individual differences, the two methods attempted in this research did not show an advantage. Author

N65-19322# Hughes Aircraft Co., Culver City, Calif. Research and Development Div.
JANAIR, JOINT ARMY-NAVY AIRCRAFT INSTRUMENTATION RESEARCH: ANALYSIS OF PICTORIAL DISPLAYS Second Quarterly Progress Report
W. L. Carel Dec. 1964 8 p
(Contract Nonr-4468(00))
(Rept.-2732.01/23; AD-609762)

Progress on the following tasks is discussed: (1) the conception of the pilot's job as a set of hierarchal tasks; (2) the development of a model for target recognition in literal pictorial displays; (3) the development of a graded series of landing and low-level flight hypothetical pictorial displays; and (4) the generation of data to fill in the cells on the chart described previously. E.E.B.

N65-19327# Joint Publications Research Service, Washington, D. C.
SOVIET RESEARCH ON TEACHING MACHINES
V. Taranov and T. Konysheva 19 Mar. 1965 13 p Transl. into ENGLISH from Nauchno-Tekhn. Obshchestva SSSR (Moscow) no. 8, Aug. 1964 p 18–21
(JPRS-29204; TT-65-30548) CFSTI: $1.00

The use of technical devices, programed texts, visual aids, and other instruction devices to cope with both the need for mass education and the need to keep abreast with the latest developments in the various disciplines is reviewed. One simple film-strip-type teaching and testing machine is described in detail. M.P.G.

N65-19351# Matrix Corp., Arlington, Va.
THE DEVELOPMENT OF A FAULT ISOLATION/CORRECTION TEXT AND TROUBLESHOOTING DIAGRAMS FOR THE AN/FST-28 SAGE COORDINATE DATA PROCESSOR Final Report, Jan.–Dec. 1964
Edward C. Weiss Bedford, Mass. AFSC, Decision Sci. Lab., Dec. 1964 22 p refs
(Contract AF 19(628)-555)
(ESD-TR-64-664; AD-611170)

These materials supplement the Job Proficiency Guide in order to enhance Phase I and Phase II troubleshooting performance. Phase I troubleshooting is defined as fault isolation to a major functional area of the equipment. Phase II troubleshooting is defined as fault isolation within a major functional area to a line replaceable unit. The Phase I diagram utilizes the built-in system readouts. The Phase II diagrams are used in conjunction with a standard oscilloscope. The trouble-shooting procedures terminate in the use of existing logic diagrams. The materials are comprehensive and account for individual differences in technician performance capability. The approach utilized to develop these materials is a further evolution and refinement of a previously developed methodology which was empirically validated in the field. Author

N65-19352# Hughes Aircraft Co., Fullerton, Calif. Ground Systems Group
SHARED SPECTRUM DISPLAY ENHANCEMENT Final Report
James G. Rogers, Marvin H. Detambel, and Ann R. Bien Bedford, Mass., AFSC, Electron. Systems Div., Jan. 1965 65 p refs
(Contract AF 19(628)-3882)
(FR-65-10-30; ESD-TDR-64-673; AD-611187)

The described illumination system displays portions of the visible spectrum which have been excluded from the ambient light. The resulting tinted illumination is matched in brightness to a standard white light by experimental subjects, and stimulus threshold measurements are made as a function of display intensity for various stimulus and ambient spectra. Certain combinations are found to lower the threshold of detection, indicating enhanced stimulus brightness, whereas others are found to raise the threshold. A close relationship is found between experimental data and results predicted on the basis of previous increment-threshold measurements. Author

N65-19353# Air Force Systems Command, Bedford, Mass. Decision Sciences Lab.
A TECHNIQUE FOR OBTAINING NON-DICHOTOMOUS MEASURES OF SHORT-TERM MEMORY
James D. Baker Dec. 1964 47 p refs
(ESD-TR-64-678; AD-610860)

The purpose of this paper is to describe a technique for measuring short-term memory (STM) not based upon dichotomous scoring criteria. The conceptual framework of this technique is derived from current theoretical developments in the measurement of subjective (personal or intuitive) probabilities. An STM feasibility study assessed this approach. Performance measures were obtained using a device that produced response vectors. These response vectors were transformed into equivalent dichotomous scores and uncertainty measures. The derived dichotomous data were compared to data obtained from equivalent, dichotomously scored studies. This comparison showed no deleterious effects on recall when this response mode was used. The uncertainty measures showed well defined evidence of the effects of proactive inhibition in this task. Confidence judgments were derived from the response vectors. These derived confidence judgments were found to be at least as good, in terms of realism of confidence measures, as several existing techniques for obtaining confidence judgments directly. Author

N65-19410# Illinois Univ., Urbana. Coordinated Science Lab.
DETECTION OF RATE CHANGES IN PERIODIC PHENOMENA
R. A. Avner Oct. 1964 17 p refs
(Contract DA-36-039-AMC-02208(E); Grant NSF G-23554)
(CSL-R-235; AD-609698)

In periodic processes, a change in period is a direct indication of a change in its reciprocal, the rate of events. An immediate consequence of sufficiently large changes in period, and hence in rate, will be changes in the number of events within time intervals, e.g., if 10 events occur in one interval and 25 in another, a rate change is assumed to have occurred. It is shown with what probability differences between numbers of observed events within a pair of time intervals may be ascribed to specified changes in rate of a periodic phenomenon. For example, with what probability is the observed difference of (25–10) = 15 events ascribed to an actual rate change of 0, 5, 10, 12, . . . events per interval. Such measures are valid for the class of phenomena, such as human heart rate, for which magnitude of rate change is relatively unrelated to base rate. E.E.B.

N65-19440# Bell Helicopter Co., Fort Worth, Tex.
COMPARISON OF PERCEPTUAL WORK LOAD IN FLYING STANDARD INSTRUMENTATION AND THE CONTACT ANALOG VERTICAL DISPLAY
D. J. Dougherty, J. H. Emery, and J. G. Curtin Dec. 1964 55 p refs
(Contract Nonr-1670(00))
(D228-421-019; AD-610617)

Reported is an experimental approach to the comparison of visual free time that results in the pilot task when flying standard instruments and when flying the contact analog vertical display. Measures of performance included absolute integrated error scores of airspeed, altitude, heading and track deviations. Results indicate that, in general, under the control condition (no digits) and the slowest reading rate condition (80 digits per 3-minute period) no statistically significant differences in performance scores existed on the display panels. As the reading rates increased progressively to the fastest rate (360 digits per 3-minute period) performance on the vertical display remained relatively stable, while performance error scores on the standard instruments increased proportionately with increased reading rates. Author

N65-19540# Joint Publications Research Service, Washington, D. C.
EFFECT OF SPACE FLIGHT ON CREW OF INTERPLANETARY VEHICLE
V. Lebedev 22 Mar. 1965 8 p Transl. into ENGLISH from Nauka i Zhizn' (Moscow), no. 12, Dec. 1964 p 15–18
(JPRS-29217; TT-65-30555) CFSTI: $1.00

The problems of selecting a psychologically and physiologically compatible crew for long interplanetary space excursions are outlined. Emphasis is placed on the presence of a physician on board the space ship who will be able to carry out direct medical observations of the crew during flight, dispense medication as needed, perform emergency operations under conditions of weightlessness, check the operations of the ecological system, and carry out observations as a zoologist, botanist, and microbiologist on the planet to be studied. G.G.

N65-19567# Navy Medical Neuropsychiatric Research Unit, San Diego, Calif.
PERSONAL HISTORY CORRELATES OF MILITARY PERFORMANCE AT A LARGE ANTARCTIC STATION
E. K. Eric Gunderson, Paul D. Nelson, and James M. Orvick Aug. 1963 9 p refs
(Rept.-64-22; AD-609542)

Relationships between biographical predictors and superiors' ratings were examined for two samples of Navy men who wintered-over at a large Antarctic base. Results for the large station personnel were very similar to those for Navy men studied earlier at smaller stations with respect to the favorability of an age–experience–rank cluster of variables and the unfavorability of past delinquency–truancy record. For a cluster of variables pertaining to needs for avocational activities, however, validity indicators tended in opposite directions for the two populations, low avocational activity being related to better adjustment at small stations. These findings demonstrated significant effects of environmental and organizational factors upon the validity of particular biographical predictors. Author

N65-19602# Pittsburgh Univ., Pa.
LEARNING SET FORMATION IN PROGRAMMED INSTRUCTION Technical Report, Oct. 1961–Oct. 1962
James H. Reynolds, Robert Glaser, and John S. Abma (AMRL) Wright-Patterson AFB, Ohio, AMRL, Nov. 1964 19 p refs
(Contract AF 33(616)-7175)
(AMRL-TR-64-114; AD-609802)

Two different orders of three units of programed instruction were administered to groups of students matched on intelligence or relevant achievement tests. Comparisons were made between groups that were high or average on each matching variable. The hypotheses being tested were that after varied amounts of prior practice in programed instruction, learning set formation would not be demonstrated by the high intelligence and achievement groups, but would be demonstrated by the average intelligence and achievement groups. Only partial support was obtained for each hypothesis. The data indicated the following: (1) In a programed sequence, error rate is a more appropriate measure than achievement for observing learning set formation. (2) Learning set formation is observable in programed instruction for all learners regardless of individual differences. Since reduced error rate was the indication of learning set formation, the phenomenon can be measured only in programs involving a moderately high error rate. (3) A moderately high error rate program which offers opportunity for correction of response errors may be

as effective in producing learning as a low error rate program which confirms correct responses. Author

N65-19607# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
INPUT UNIT FOR IBM 024 PRINTING CARD PUNCH [UNITA D'INGRESSO PER PERFORATRICE IBM 024]
A. Rosati 16 Nov. 1964 17 p In ITALIAN; ENGLISH summary
(ISS-64/39)

This report contains the description of an electromechanical circuit. This circuit allows the conditioned and unconditioned reflexes in a cage-enclosed rat under periodical light and voltage pulses to be punched directly on a card. Wiring and diagrams of the whole circuit are reported, and examples and results of experiments with such an apparatus are then presented. Author

N65-19626# Carnegie Inst. of Tech., Pittsburgh, Pa. Graduate School of Industrial Administration
THE EFFECTS OF GOAL DIFFICULTY ON PERFORMANCE: A FIELD EXPERIMENT
Andrew C. Stedry and Emmanuel Kay (GE) Nov. 1964 29 p refs Sponsored by GE
(Contract Nonr-760(24))
(ONR-RM-135; AD-609508)

The effect of goal difficulty on performance was determined by studying two performance areas. These were productivity and rework. The subjects, foremen in a department of a precision parts manufacturing plant, had previously been measured for these two quantities. Goal perception was then varied and the two quantities measured. Detailed discussion of the experiment and results are presented. E.E.B.

N65-19689*# Massachusetts Inst. of Tech., Cambridge. Man-Vehicle Control Lab.
STUDIES OF HUMAN DYNAMIC SPACE ORIENTATION USING TECHNIQUES OF CONTROL THEORY Second Semi-annual Status Report
L. R. Young and Y. T. Li Dec. 1964 27 p refs
(Grant NsG-577)
(NASA-CR-57292) CFSTI: HC $2.00/MF $0.50

The development of research equipment and methods, specific experimental and analytical results obtained using this equipment, and preliminary experiments are summarized. Abstracts on the following research are included: Bang-bang aspects of manual control in high order systems; manual control of an unstable system with visual and motion cues; the roles of men and instruments in control and guidance systems for spacecraft; comparison of relay and manual controllers for systems with high order dynamics; human response to variations of simulated control stick forces; the design and construction of an acceleration cart; and human performance during a simulated Apollo midcourse navigation sighting. E.E.B.

N65-19749*# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
A SAMPLED-DATA PURSUIT TRACKING MODEL
J. G. Kreifeldt 15 Jan. 1965 27 p refs
(Grant NsG-107-61)
(NASA-CR-57221; DSR-9991-2) CFSTI: HC $2.00/MF $0.50

A sampled-data pursuit hand tracking model for the human operator is developed and tested. The model embodies the simplest a priori assumptions about human tracking behavior. The analytical model is presented along with the experimentally determined frequency transfer characteristics of an analog computer built to have the same transmittance as the mathematical model. Generally good agreement was obtained in matching the model's frequency and time domain responses to those of a well-trained human, tracking in pursuit fashion an input power spectrum flat to 0.64 cps. Author

N65-19805# Gt. Brit. Dept. of Scientific and Industrial Research. Warren Spring Lab.
HUMAN SCIENCES IN INDUSTRY. PART I: ERGONOMICS Annotated Bibliography
Dec. 1964 141 p refs

Ergonomics, methods, facilities, equipment, and general references; systems of men and machines; visual inputs and processes; auditory inputs and processes, including speech production and intelligibility; other sensory inputs and processes; choice and interaction; body measurements, basic physiological capacities, basic and complex motor performance; design of controls and integration with displays; layout of panels and consoles; design of work space, equipment, and furniture; clothing and personal equipment; special environmental factors affecting performance; individual factors, work conditions, and task characteristics that affect behavioral efficiency; training aids and devices; and other areas of psychological research pertinent to ergonomics are the 15 areas covered by this annotated bibliography. E.E.B.

N65-19903*# Stanley Aviation Corp., Denver, Colo.
A STUDY OF THE DYNAMIC MODEL TECHNIQUE IN THE ANALYSIS OF HUMAN TOLERANCE TO ACCELERATION Final Report
Washington, NASA, Mar. 1965 227 p refs
(Contract NASr-37)
(NASA-TN-D-2645) CFSTI: HC $6.00/MF $1.25

A single-degree-of-freedom dynamic model was developed. The model consists of a spring-mass analog of the human body that can be used to predict human tolerance to abrupt accelerations. Variations of the basic model can be used to predict the quantitative effects of restraint systems and seat cushions. D.E.W.

N65-19993# Fordham Univ., New York. Dept. of Psychology
ANALYSIS OF POLYGRAPHIC DATA Final Report
Joseph F. Kubis Griffiss AFB, N.Y., RADC, Jan. 1965 42 p refs
(Contract AF 30(602)-2634)
(RADC-TDR-64-101; AD-612034)

Two types of decision situations are characteristic of lie detection investigations: the dependent judgment case in which the examiner, after comparing all records, selects the guilty individual (and possibly accomplices) from among a group of suspects known to include the culprit(s); and, the independent judgment case, in which a decision of innocence or guilt is made independently for each suspect on the basis of his record alone. The results indicate that neither accuracy of decisions nor confidence in them was diminished under independent judgment conditions. Records of 33 subjects from the simulated theft experiment were selected for further analysis and measurement of the three physiological response systems. These measured characteristics were found to be as accurate as the ratings of the lie detector operators in discriminating between culprit, collaborator, and innocent suspect. Continued research should make it possible to objectify most of the lie detection indices with the aid of a computer. Author

N65-20096# Joint Publications Research Service, Washington, D. C.
THE PERSPECTIVE USES OF INTROSCOPY
P. O. Oshchepkov 22 Mar. 1965 6 p Transl. into ENGLISH from Izv. (Moscow), 5 Feb. 1965 p 3
(JPRS-29212; TT-65-30552)

Present instrumentation, techniques, and applications in the field of introscopy, or direct vision into nontransparent bodies and media, are reviewed. Applications in medicine and industrial quality control are emphasized. E.P.V.

N65-20098# Joint Publications Research Service, Washington, D. C.
RUMANIAN ACHIEVEMENTS IN NEUROCYBERNETICS—ARTIFICIAL INTELLIGENCE
A. Nistor 24 Mar. 1965 8 p Transl. into ENGLISH from Stiinta Si Tehnica (Bucharest), no. 2, Feb. 1965 p 24-25 (JPRS-29267; TT-65-30578) CFSTI: $1.00

Three electronic and mathematical Rumanian achievements in neurocybernetics—matrix of 49 neurons, artificial voices, and the transmission of information through the synapse—are reviewed. The functioning of a group of neurons was simulated by a model matrix of $7 \times 7 = 49$ neutrons. Each neuron was characterized by three values—excitation level, excitability, and permeability of the synapse. Their values were computed by means of recurrence formulas. A machine which recognizes the vowels of the Rumanian language spoken into a microphone, and one which produces an artificial voice capable of pronouncing these vowels is explained. Also, research on the logical diagram of the neuron and transmission of information through the synapses is included. The equivalent logical diagram consists of filters which receive impulses; an adding circuit collects the impulses leaving the filters and sends them to a threshold device, which permits passage if the total exceeds a certain value. E.E.B.

N65-20120# Lockheed-California Co., Burbank.
TOXIC CONTAMINATION OF MANNED SPACECRAFT CABINS: A REVIEW OF THE PROBLEM
Charles A. Spezia Apr. 1964 87 p refs
(LR-17744)

Among the potential hazards of manned space flight is the buildup of toxic contaminants in the cabin atmosphere and in the water supply. Briefs are presented of current research directed toward an effective control system, from the viewpoint of toxicological hazard to a spacecraft crew. Recommendations are included for minimizing contamination, and references from a literature survey are listed. E.P.V.

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N65-18659# Naval Ordnance Lab., White Oak, Md. Chemistry Research Dept.
ON THE VALENCE OF SILVER IN ARGENTIC OXIDE
George L. Cohen and Elinor H. Ostrander Jun. 1964 11 p refs
(NOLTR-64-13; AD-601196)

The results of a literature survey on the valence of silver in argentic oxide (AgO) are presented. Physical and chemical evidence indicates the presence of both trivalent and monovalent silver in argentic oxide, but no divalent silver. Author

N65-18668# Calvin Coll., Grand Rapids, Mich.
SILVER MIGRATION AND TRANSPORT MECHANISM STUDIES IN SILVER OXIDE-ZINC BATTERIES Final Report
T. P. Dirkse Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Dec. 1964 75 p refs
(Contract AF 33(615)-1236)
(AFAPL-TR-64-144; AD-610563)

Methods for testing the ability of separator materials to allow the diffusion of dissolved silver oxides, zincate ions, and hydroxide ions, have been checked to determine the reproducibility of the diffusion rates obtained by these methods. The results have also been studied to determine the applicability of Fick's first law of diffusion to these processes. The use of surfactants in the electrolyte and in the zinc electrodes has been studied. The effect of these substances on cycle life and on various zinc electrode processes was measured. Various aspects of the decomposition of silver oxide in aqueous KOH were studied, particularly the effect of solid materials, some ions, and separator materials. A possible mechanism for these effects is given. This decomposition is very closely related to the deposition of silver on the separators in silver–alkaline batteries. Author

N65-18672# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
DETERMINATION OF STYRENE MONOMER IN POLYESTER RESINS BY GAS-LIQUID CHROMATOGRAPHY Final Report
George G. Esposito 3 Dec. 1964 15 p refs
(CCL-173; AD-609664)

Styrene, as well as other unsaturated monomers, is employed as a cross-linking agent for unsaturated polyesters resins, and a suitable method of analysis for styrene is needed. In this investigation gas–liquid chromatography (GLC) is used to determine styrene monomer without interference from other cross-linking compounds. A simple, solvent separation is used to separate the resin prior to the GLC analysis. The GLC separation was conducted on a Triton X-305 column with methyl isobutyl ketone (MIBK) used as the internal standard. Author

N65-18673# Aberdeen Proving Ground, Md. Coating and Chemical Lab.
DEVELOPMENT OF A PROCEDURE FOR DETERMINING TRACE QUANTITIES OF ZINC IN AIRCRAFT AND AUTOMOTIVE ENGINE FUELS Final Report
Maurice E. Le Pera 31 Dec. 1964 33 p refs
(CCL-174; AD-610704) CFSTI: $0.75

A dithizone spectrophotometric procedure has been developed for the determination of trace amounts of zinc in aviation and automotive engine fuel. The analysis of zinc in fuel containing alkyl lead antiknock involves a modification requiring the electrolytic removal of lead and the complexing of residual traces of the same element with sodium diethyl dithiocarbamate. It was found that with fuels not requiring alkyl lead antiknock the developed method gave an average error from −0.2 to +0.3 ppm in the range of 1 to 15 ppm zinc whereas the modification for use with fuels requiring alkyl lead antiknock gave a positive error amounting to 1.5 to 3.5 ppm depending on zinc concentration. Author

N65-18674# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
A STUDY OF VARIOUS INHIBITORS FOR PREVENTION OF GALVANIC CORROSION Final Report
W. H. Deaver 4 Jan. 1965 9 p ref
(CCL-175; AD-610136)

Various types of corrosion inhibitors and metallic salts were evaluated to determine their ability to prevent or retard galvanic corrosion of magnesium–steel assemblies. Screening tests showed sodium mercaptobenzothiazole (NaMBT) to be the most effective for prevention of galvanic corrosion on specimens immersed in a 3% salt solution. An attempt was then made to utilize NaMBT in a pretreatment for magnesium–steel couples. A procedure was developed for anodically depositing a coating from a NaMBT bath; however, the coating produced failed to provide the desired corrosion resistance. Author

N65-18679# Army Missile Command, Huntsville, Ala. Redstone Scientific Information Center
THERMOGRAPHIC METHOD OF DETERMINING HEAT EFFECT
A. F. Kapustinskiy and Yu. P. Barskiy Jan. 1965 16 p refs Transl. into ENGLISH from Izv. Sektora Fiz.-Khim. Analiza, Akad. Nauk SSSR, vol. 20, 1950 p 317–325
(RSIC-362; AD-610423)

A method of recording thermal curves which permits quantitative measurement of heat effect data and heat capacities is presented. In order to calculate the thermal effect from the heating curve, it is necessary to know the duration of the interval, the difference in temperature between the test sample and the furnace, and the coefficient of thermal conductivity. This last requirement depends on many factors including the properties of the sample itself, and is difficult to reproduce with accuracy, especially for nonmetals. The essence of the technique proposed is that control over the influx of heat to the specimen being heated is accomplished outside the sample; thus the quanitity of heat received by the specimen does not depend upon its properties. The specimen whose heating curve is being recorded is placed inside an insulating jacket. A constant temperature drop is maintained between the outer and inner walls of the jacket. The rate of heat intake in this case is completely fixed and reproducible. R.L.K.

N65-18699# Pittsburgh Univ., Pa.
SOME CHEMICAL PROPERTIES OF EXCITED STATES Final Report
J. L. Rosenberg 20 Dec. 1964 51 p refs
(Contract AF 19(604)-8354)
(AFCRL-64-1025; AD-610640)

Aqueous solutions of acriflavine fail to obey Beer's Law. The spectroscopic data are explained in terms of a monomer–dimer equilibrium for the dye, with a dimer dissociation constant of 5×10^{-3} M at 25° C. The dimer may be stabilized by hydrophobic bonding and is of the nonparallel type. The decay of phosphorescence of adsorbates of acriflavine on silica gel is the sum of two first-order processes. The similarity of spectroscopic features of the adsorbates and the solutions suggests that dimers and monomers are the two components in the adsorbate. Oxygen quenches the phosphorescence of the adsorbates by forming a preillumination complex with the dye. The actual lifetime of phosphorescence of each dye component is invariant from 0% to 90% quenching by oxygen. At high populations of dye triplets, oxygen stimulates a blue-shifted luminescence and is itself consumed. An inert gas can inhibit the enhancement of luminescence and the consumption of oxygen if the inert gas, like N_2O, CH_4, and CO_2, has a vibrational spacing close to those occurring in O_2. The O_2 is assumed to acquire vibrational energy in the initial quenching process and to use this as an energy of activation for subsequent dark reactions which are chemiluminescent. The initial enhanced quenching on the addition of mixtures of O_2 with CO_2 or N_2O was shown to be a sensitive indicator of the adsorption of these gases on the surface of silica gel.
Author

N65-18713 Joint Publications Research Service, Washington, D. C.
SCANDIUM-CONTAINING FERRITES
D. Ye. Bondarev *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 130–142 refs (See N65-18701 09-17) CFSTI: $7.00

Development of new scandium ferrites with low induction (on the order of 800 to 1000 gauss), suitable for rapid-action systems of a broad class of computer memories, is reported. The theoretical plan for creating new properties of low-induction ferrites proceeded from the Néel theory of ferrimagnetism. Data on flux characteristics indicate that the induction and coercive force of various scandium ferrites can be widely varied. J.M.D.

N65-18718 Joint Publications Research Service, Washington, D. C.
INFLUENCE OF DEOXIDATION BY RARE EARTH METALS ON THE DEFORMABILITY OF MOLYBDENUM
Ye. M. Savitskiy, V. V. Baron, and V. A. Frolov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 179–183 refs (See N65-18701 09-17) CFSTI: $7.00

The positive influence of the rare earth metals on the deformability of molybdenum was established. A number of master alloys were developed, facilitating the introduction of the rare earth metals into molybdenum. Alloys were smelted, possessing better deformability in comparison with nondeoxidized molybdenum; the alloys prepared were processed by forging and rolling with a large degree of deformation at a temperature of 700° without breakdown. Author

N65-18719 Joint Publications Research Service, Washington, D. C.
CRYSTAL STRUCTURE OF SILICIDES AND GERMANIDES OF THE RARE EARTH METALS
Ye. I. Gladyshevskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 184–187 refs (See N65-18701 09-17) CFSTI: $7.00

Compounds of silicon and germanium with the rare earth metals of the yttrium group were prepared to investigate the crystal structures of the unstudied disilicides and digermanides of the rare earth elements. Data obtained by X-ray diffraction studies of these compounds are tabulated, including lattice constants, structural type, and composition. Phase analyses were also conducted. M.P.G.

N65-18720 Joint Publications Research Service, Washington, D. C.
COMPOUNDS OF THE RARE EARTH METALS WITH ALUMINUM AND THEIR CRYSTAL STRUCTURES
P. I. Kripyakevich and I. I. Zalutskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 188–190 refs (See N65-18701 09-17) CFSTI: $7.00

Binary alloys of cerium, praseodymium, europium, and erbium with aluminum were prepared and investigated. Among the results reported are these: (1) A structure of the CsCl type was found for CeAl. (2) In the Pr–Al system were found a compound of the CsCl type, two modifications of Pr_3Al, and $PrAl_4$ structurally resembling $BaAl_4$. (3) The structure of a compound Eu with 75 at. wt% Al resembled that of $BaAl_4$. (4) In the Er–Al system, the compound richest in aluminum was $ErAl_3$ with a structure resembling $AuCu_3$. (5) The $ScAl_2$ and $ScAl_3$ were found in the Sc–Al system, the latter existing in equilibrium with aluminum. Apparently, the compositions of the compounds richest in aluminum depend on the atomic radii of the rare earth metals. M.P.G.

N65-18721 Joint Publications Research Service, Washington, D. C.

COMPOUNDS OF THE RARE EARTH METALS WITH MAGNESIUM AND THEIR CRYSTAL STRUCTURES

P. I. Kripyakevich and V. I. Yevdokimenko *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 191–194 refs (See N65-18701 09-17) CFSTI: $7.00

Alloys of the rare earth metals and yttrium with magnesium were studied by X-ray diffraction. The formulas, structural types, and lattice parameters obtained are tabulated. In the rare earth metal–magnesium systems of the cerium group, the compound richest in magnesium possesses the composition R_2Mg_{17} or RMg_{12}; in the yttrium group the composition is R_5Mg_{24}. M.P.G.

N65-18726 Joint Publications Research Service, Washington, D. C.

STUDY OF THE PHASE DIAGRAM OF THE La_2O_3-Cr_2O_3 SYSTEM

S. G. Tresvyatskiy and V. N. Pavlikov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 207–212 refs (See N65-18701 09-17) CFSTI: $7.00

The results obtained on the investigation of the system La_2O_3-Cr_2O_3 in argon and air permit representation of this system as binary with an intermediate chemical compound with a 1:1 composition, melting without decomposition. The phase diagram of La_2O_3-Cr_2O_3 in argon medium possesses the following eutectics: (1) between Cr_2O_3 and $LaCrO_3$, with the composition 18 ±2 mol.% La_2O_3 and 82 ±2 mol.% Cr_2O_3. This eutectic melts at 2080° ±20°; (2) between $LaCrO_3$ and La_2O_3, with the composition 80 mol.% La_2O_3 and 20 mol.% Cr_2O_3. This eutectic melts at 2060° ±20°. The phase diagram of La_2O_3-Cr_2O_3, investigated in air medium, possesses the following eutectics: (1) between Cr_2O_3 and $LaCrO_3$ with the composition 24 mol.% La_2O_3 and 76 mol.% Cr_2O_3. This eutectic melts at 2230° ±30°; (2) between $LaCrO_3$ and La_2O_3, with the composition 78 mol.% La_2O_3 and 22 mol.% Cr_2O_3. This eutectic melts at 2130° ±30°. The melting point of lanthanum chromite was determined as equal to 2530° ±30° Author

N65-18727 Joint Publications Research Service, Washington, D. C.

CHEMICAL COMPOUNDS OF THE SCANDIUM-BORON SYSTEM AND THEIR PROPERTIES

G. V. Samsonov, T. S. Verkhoglyadova, and S. A. Vdovenko *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 213–216 refs (See N65-18701 09-17) CFSTI: $7.00

Various reactions are described in which Sc_2O_3 was combined with boron and carbon in production of scandium borides. Data on ScB_2 and ScB_4 are presented which show linear dependence of electric resistance on temperature. Oxidation curves for ScB_2 exposed to air at various temperatures are shown. J.M.D.

N65-18729 Joint Publications Research Service, Washington, D. C.

METALLOTHERMAL METHOD OF PRODUCING ALUMINIDES OF THE RARE EARTH METALS, THEIR PROPERTIES AND REGIONS OF APPLICATION

V. A. Podergin and G. V. Samsonov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 227–233 refs (See N65-18701 09-17) CFSTI: $7.00

Investigation of the aluminothermal reduction of the oxides of lanthanum (La_2O_3), cerium (CeO_2), and praseodymium (Pr_6O_{11}) for the production of master alloys and aluminides of the rare earth metals (REM). The optimal thermal capacity for maximum yield of REM in alloy was determined for an out-of-furnace method. Conditions for aluminothermal reduction of lanthanum and cerium oxides to the pure metal were studied using a vacuum aluminothermy technique. It is recommended that alloys rich in REM (above 30%), possessing high melting points, should be used in production of master alloys. J.M.D.

N65-18730 Joint Publications Research Service, Washington, D. C.

SEMICONDUCTOR AND CERTAIN OTHER PHYSICAL PROPERTIES OF THE SULFIDES OF LANTHANUM, CERIUM, PRASEODYMIUM, AND NEODYMIUM

V. I. Marchenko *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 234–237 refs (See N65-18701 09-17) CFSTI: $7.00

Temperature dependence was investigated for the specific resistance of the mono- and sesquisulfides of lanthanum, cerium, praseodymium, and neodymium within the temperature interval 20° to 1000° C. On the whole, results show that the metal–sulfur ionic bonds are strongly pronounced in the metal sulfide lattices. The thermal stability of the sulfides under vacuum and in contact with molten metals is dependent on these lattice bonds, as is the high refractory quality of the monosulfides. E.P.V.

N65-18731 Joint Publications Research Service, Washington, D. C.

PRODUCTION OF THE DOUBLE BORIDE OF LANTHANUM AND SODIUM AND STUDY OF SOME OF ITS PHYSICAL AND CHEMICAL PROPERTIES

G. V. Samsonov, V. A. Obolochnik, Yu. V. Paderno, R. V. Serbina, V. S. Fomenko et al *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 238–243 refs (See N65-18701 09-17) CFSTI: $7.00

The double boride $(La,Na)B_6$ was produced by electrolysis of fused media. It was shown that its crystal structure corresponds to the CaB_6 type, the lattice periods increasing with increasing sodium content. Investigations were made of a number of physical and chemical properties of the compound obtained. On the basis of the experimental data obtained, conclusions were drawn on the change in the structure of lanthanum hexaboride upon introduction of an alkali metal into its composition. Author

N65-18732 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF THE RARE EARTH METALS ON THE STRUCTURE AND MECHANICAL PROPERTIES OF THE SEAM METAL

T. M. Slutskaya *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 244–249 refs (See N65-18701 09-17) CFSTI: $7.00

A steel wire electrode has been developed in connection with a method for open-arc welding of high-quality seams; this method is to replace gas-protected welding. It was established that the introduction of rare earth metal (REM) into the composition of the electrode wire exerts a substantial influence on the welding process. Tests of the wire for industrial development and comparison with production brands are discussed. E.P.V.

N65-18736 Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE INFLUENCE OF RARE EARTH METALS ON THE QUALITY OF STAINLESS STEELS AND STEEL R18

V. S. Vvedenskiy, K. K. Prokhorenko, P. L. Zhdanov, G. V. Semenchenko, N. Ye. Vasil'yev et al *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 279-285 (See N65-18701 09-17) CFSTI: $7.00

The introduction of about 0.2% Ce into stainless steels raises their plasticity during hot deformation. When the amount of cerium is increased to 0.4%, the plasticity deteriorates on account of the formation of specific flaws in the zone of the ingot below the crust. When the cerium consumption for the modification of steel is increased, the character of the distribution of carbides in the case metal changes. The introduction of cerium into steel leads to the formation of a new type of nonmetallic inclusions, apparently representing cerium oxysulfides. The cerium oxysulfides are arranged nonuniformly in the volume of the metal and chiefly form accumulations of point inclusions. With increasing cerium consumption, there is a sharp decrease in the amount of sulfides of manganese and iron and that of silicates. Author

N65-18791 United Kingdom Atomic Energy Authority, Harwell (England). Radiochemical Centre

THE ABSOLUTE STANDARDISATION OF ZIRCONIUM-95

G. D. M. Parker Jun. 1964 34 p refs
(RCC-R-175) HMSO: 4s 6d

A method for the absolute standardization of zirconium-95 in solution is described, using 4 π beta-gamma coincidence counting. The basis of the method is to carry out repetitive standardizations on counting sources prepared from the solution of (zirconium-95 + niobium-95), and fit the results arithmetically to a theoretical growth and decay curve, to obtain the radioactive concentration of both zirconium-95 and niobium-95 in the solution. An actual experiment is described, and the results of the standardization are given, together with a critical survey of the errors involved. Equations are derived for evaluating the magnitude of the theoretical errors in the results. Author

N65-18800# Naval Civil Engineering Lab., Port Hueneme, Calif.

THE ELECTROCHEMICAL BEHAVIOR OF ARMCO IRON IN SULFURIC ACID

Howard A. Porte and Thomas E. Nappier 31 Jan. 1964 27 p refs
(TN-568; AD-600563) CFSTI: $1.00

The polarization behavior of iron in sulfuric acid solutions was investigated. Anodic and cathodic polarization curves were obtained using aerated and deaerated solutions of 1N and pH1 sulfuric acid by galvanostatic and potentiostatic methods. Author

N65-18857# Harshaw Chemical Co., Cleveland, Ohio. Central Research Lab.

INVESTIGATION OF THE EXISTENCE OF OXYANIONS OF FLUORINE AND NITROGEN AND THE NITROGEN-FLUORINE CATIONS Quarterly Technical Summary Report, 28 Oct. 1964-28 Jan. 1965

Gerald L. Hurst and S. I. Khayat 28 Feb. 1965 18 p ref
(Contract DA-31-124-ARO(D)-76; ARPA Order-402)
(HQ-76-8; AD-457841)

The following results are reported: (1) The IR peak intensities of nitrogen fluorides and oxides are usually strongly pressure dependent. (2) Tetrafluorohydrazine can be removed from *trans*-N_2F_2 by washing with water in the presence of oxygen or with concentrated nitric acid. The latter procedure may result in detonation. (3) Like NF_3, N_2F_4 is subject to nucleophilic attack in aqueous solution but the apparent reaction rates do not necessarily vary directly with nucleophilicity. (4) Certain aqueous metal salts, and in particular iron salts, react with or catalyze the hydrolysis of N_2F_4. (5) A variety of anhydrous metal salts react with N_2F_4 over a wide range of conditions. A number of these salts yield *trans*-N_2F_2 and at least one ($NiCl_2$) appears promising as a preparative reagent. Author

N65-18859# Picatinny Arsenal, Dover, N. J.

THE DECOMPOSITION OF THALLOUS CYANAMIDE

V. I. Siele and F. C. Tompkins (Imperial Coll. of Sci. and Technol.) Jan. 1965 23 p refs
(PA-TR-3201; AD-457879)

The isothermal decomposition of thallium cyanamide has been investigated. The decomposition takes place in four distinct stages over the temperature ranges of 400° to 480° C, 480° to 640° C, 640° to 740° C, and 740° to 1000° C. The pressure-time curves reveal that these stages occur as consecutive reactions which follow first-order kinetics. The fourth consecutive reaction probably consists of two concurrent reactions so that the overall reaction can be represented by

$$A \xrightarrow{k_1} B \xrightarrow{k_2} C \xrightarrow{k_3} \begin{matrix} D \\ k_4 \searrow \swarrow k_5 \\ E \end{matrix} + E$$

The temperature variation of the unimolecular constants of stages one, two and three are $9 \times 10^5 e^{-30.8}$ kcal/RT, $8 \times 10^{10} e^{-56.5}$ kcal/RT and $2 \times 10^{15} e^{-82}$ kcal/Rt, respectively. Author

N65-18879# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials

CsCl-TYPE COMPOUNDS IN BINARY ALLOYS OF RARE EARTH METALS WITH ZINC AND COPPER

C. C. Chao, H. L. Luo, and P. Duwez Jul. 1963 8 p refs
(Contracts AT(04-3)-221; Nonr-220(30))
(TR-17; AD-414937)

Compounds of equiatomic composition of Cu with Sm, Tb, Dy, Ho, Tm and of Zn with Y, Nd, Sm, Gd, Tb, Dy, Ho, Er, and Tm were found to crystallize into the CsCl (B2-type) structure. The lattice parameters of these compounds vary linearly with the trivalent ionic radii of the rare-earth elements. Author

N65-18898# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

SPECTROSCOPIC STUDIES OF THE VAPORIZATION OF REFRACTORY MATERIALS Final Report

Milton J. Linevsky 30 Nov. 1964 61 p refs
(Contract AF 33(615)-1150; ARPA Order 24)
(AD-609121)

The technique of matrix isolation was used to obtain the infrared spectra of several high-temperature molecules. A double boiler and reaction oven-type Knudsen cell technique were added to the general methods of matrix isolation, resulting in greater versatility of the method. Differentiation between monomer and polymer spectra appears to be entirely possible. The following molecules were studied: MgF_2, AlF_3, Li_2F_2, ThO_2, ThO, ZrO_2, and ZrO. In most cases, tentative frequency assignments were made, and structural properties were inferred. Atomic resonance line absorption studies were carried out on HfB_2, TiN, and ZrN. Heats of formation were obtained, based on the observed vapor pressures. Author

N65-18902# East Anglia Univ., Norwich (England). School of Chemical Sciences
THE CONFORMATIONAL ANALYSIS OF SATURATED HETEROCYCLIC COMPOUNDS Final Technical Status Report, 1 Oct. 1963–30 Sep. 1964
A. R. Katritzky [1964] 31 p refs
(Contract DA-91-591-EUC-3106)
(AD-453356)

Steric requirements—Methyl >> solvated lone pair > hydrogen atom > free lone pair—are defined as follows: (1) Dipole moments of suitably substituted piperidines show that in an *n*-methylpiperidine the methyl group exists almost entirely in the equatorial position, with the lone pair axial. Piperidines which do not carry a substituent in the 1-position also exist with the lone pair predominantly axial, at least in benzene solution. (2) The equilibrium position on epimerizing methyl 1-methyl-1-aza-*cis*-decalin-4-carboxylate compares the steric requirements of a nitrogen lone pair with a hydrogen atom. In glyme solution the (free) lone pair is found to be smaller than a hydrogen atom, but in methanol solution the hydrogen-bonded lone pair is larger than a hydrogen atom. (3) Kinetics of methiodide formation of various methylquinolizidines allow calculation of *cis–trans* equilibria for these compounds. Author

N65-18928# North Carolina Univ., Chapel Hill.
[MATERIALS SCIENCE RESEARCH] Technical Progress Report, 1 Jul. 1963–30 Jun. 1964
M. Silver et al Jul. 1964 56 p refs
(Contract ARPA SD-100)
(AD-609367)

In organic crystals research, simultaneous double photon absorption was observed in crystals of anthracene. Since the exciting radiation which originated from a medium-energy high-intensity xenon flash lamp was presumably incoherent, the implied requirement of an intense monochromatic coherent light source to produce simultaneous double photon absorption was eliminated. Only an intense source is required. Crystalline anthracene was prepared and doped with ^{14}C labeled impurities of similar size and shape as the anthracene molecule. Both self-diffusion and impurity diffusion were studied, as well as hole trapping on the same crystals. A different method of studying radiationless singlet to triplet conversion was developed and applied to gas phase anthracene, naphthalene, and phenanthrene. Research summaries on crystallography, superconductivity, magnetism, liquids, electrochemistry, and analytical techniques are also included. R.L.K.

N65-18935*# Mallory (P. R.) and Co., Inc., Burlington, Mass. Lab. for Physical Science
RESEARCH AND DEVELOPMENT OF A HIGH CAPACITY NONAQUEOUS SECONDARY BATTERY First Quarterly Report
[1965] 57 p
(Contract NAS3-6017)
(NASA-CR-54319) CFSTI: HC $3.00/MF $0.50

The general theory pertaining to electrochemical measurements under conditions of dilute solutions without a supporting electrolyte is discussed. The basic problems and fundamental limitations of various nonaqueous systems were determined, and a detailed screening program was developed. It was concluded: (1) The solubility of cathodic salts must be reduced to less than at 10^{-4}M. (2) The reversibility of the lithium electrode is not efficient. (3) The preparation and purification of solvent and solute electrolytes are of prime importance. (4) The electrode fabrication is dependent on the particular nature of the electrode reaction. (5) The rate with which electroactive participants can be supplied to the electroactive sites is important for conductivity. Prototype cells were studied, and the results presented. G.G.

N65-18960*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SPECTROGRAPHIC SOLUTION ANALYSIS OF ALUMINUM ALLOYS
D. Hamilton and S. Corbitt 20 Jan. 1965 21 p
(NASA-TM-X-53192) CFSTI: HC $1.00/MF $0.50

To obtain accurate analyses of metals and alloys with the most widely used technique of spectrographic analysis, i.e., the point-to-plane spark technique, the standards and the unknown material must be quite similar in size, shape, chemical composition, and metallurgical state. By dissolving the sample and using the vacuum-cup spark technique to analyze the solution, these limitations can be circumvented. Standards can be synthesized easily by mixing aliquots of master reference solutions. The solution technique also offers the possibility of adding an internal standard and thereby obtaining a wider selection of reference lines to use in the analysis. The solution spectrographic method was applied to a wide variety of analytical problems. As an example, the procedure for the determination of Mn, Zr, Mg, V, Ti, and Fe in types 2219 and 2319 aluminum alloy is presented. Author

N65-18969# Polytechnic Inst. Brooklyn, Freeport, N. Y.
THE DETERMINATION OF THE ORDER OF A SIMPLE REACTION Interim Report
Egon Krause Wright-Patterson AFB, Ohio, ARL, Oct. 1964 16 p refs
(Contract AF 33(616)-7661)
(ARL-64-177; AD-609976)

A method is presented whereby the order of a simple reaction may be determined. The rate constant in the rate expression is eliminated by means of the integrated rate expression. In this manner unique relations between the nondimensionalized rate and the reacted fraction are obtained for arbitrary orders. Plots constructed from these relations may be used to determine the order of a reaction when concentration measurements as a function of the reaction time are available. Author

N65-18992# TRACOR, Inc., Austin, Tex.
ELECTROCHEMICAL STUDIES IN THE SYNTHESIS OF N-F COMPOUNDS Quarterly Status Report No. 7, 1 Jul.–30 Sep. 1964
Larry G. Spears, Larry D. Fiel, Wallace E. Harrell, Jr., and Margaret H. Northrup 8 Jan. 1965 30 p
(Contract Nonr-4054(00); ARPA Order 399)
(TRACOR-65-103-U; AD-609959)

Work was devoted primarily to studying the electrode reactions that occur on Monel electrodes during the electrochemical fluorination of ammonium ion in anhydrous hydrogen fluoride (AHF) and to investigating possible new electrode materials. Film resistance and cathodic stripping measurements were performed on Monel electrodes. Weight loss measurements, at open circuit and at a constant anodic potential, and anodic polarization studies were performed on Hastelloy-F, cadmium, and zinc electrodes in AHF. Both cadmium and zinc corroded rapidly in AHF, but Hastelloy-F exhibited an extremely low corrosion rate. Several types of liquid and gas IR cells have been investigated. Calibration IR spectra were made to determine their lower limits of detection for NF_3(g). Author

N65-19000# Naval Ordnance Lab., White Oak, Md.
SYNTHESIS OF CYCLIC ETHERS FROM 1,5-CYCLOOCTADIENE Interim Report
Angelo A. Volpe and William J. Bailey Jan. 1965 14 p refs
(NOLTR-64-135; AD-609987)

The diformate of 1,5-dihydroxy-2,6-cyclooctyl oxide was synthesized from 1,5-cyclooctadiene. The dihydroxy compound itself was prepared from the diformate by alkaline hydrolysis and a diacetate derivative of the dihydroxy compound was synthesized by standard methods. While the diformate and diacetate compounds are of general interest as intermediates for the synthesis of systems containing a cyclic ether structure, the dihydroxy compound is of particular interest as a monomer for the synthesis of unique polyester-type polymers. A mechanism which involves a transannular reaction is postulated for the formation of cyclic ethers from the diene, and this mechanism is compared to the standard olefin hydroxylation mechanism with respect to the products expected from each reaction sequence. The proof of structure of the compounds synthesized was determined by elemental and infrared analysis. Author

N65-19031# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT REACTIONS OF 8-OXYQUINOLINE TRIBUTOXY TITANIUM WITH α, ω-DIHYDROXY-POLYDIMETHYLSILOXANE
K. A. Andrianov and I. A. Lavygin 1 Dec. 1964 8 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (USSR), no. 10, 1963 p 1857–1859
(FTD-TT-64-440/1; AD-609787)

The reaction of the interaction of α, ω-dihydroxy-polydimethylsiloxane with 8-oxyquinoline tributoxy titanium was studied for the purpose of clearing up the possibility of the formation of oligomers with hydroxyl groups on the terminations of extractions. In examining the heterofunctional condensation of α, ω-dihydroxy-polydimethylsiloxanes with 8-oxyquinoline-tributoxy-titanium it was found that 8-oxyquinoline-tributoxy-titanium reacts with α, ω-dihydroxy-polydimethylsiloxanes only with the substitution of the butoxy groups in the case of titanium, but the 8-oxyquinoline group meanwhile is not replaced. Author

N65-19036# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DENSITY AND VISCOSITY OF NITROGEN TETROXIDES SOLUTIONS IN 70% NITRIC ACID
M. M. Karavayev and V. A. Zhantalay 21 Jan. 1965 8 p refs Transl. into ENGLISH from Zh. Fiz. Khim. (Moscow), v. 37, no. 12, 1963 p 2771–2773
(FTD-TT-64-879/1; AD-611087)

The density and viscosity of nitrogen tetroxide in 70.05% and 71.16% nitric acid solutions were determined at −10°, 10°, and 20° C. It was observed that nitrogen tetroxide solutions change rectilinearly in density with change in concentration and temperature. The viscosity was observed to remain practically constant within the limits of accuracy of the experiment with change in concentration. Viscosity increase with temperature was observed. E.E.B.

N65-19037# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYNTHESIS OF ORGANIC COMPOUNDS AS ADMIXTURES TO LUBRICATING OILS
A. M. Kuliyev 21 Jan. 1965 7 p Transl. into ENGLISH from Vestn. Akad. Nauk SSR (Moscow), no. 7, 1962 p 51–53
(FTD-TT-64-880/1; AD-611076)

Compounds used as antifreeze, detergent, antiscale, and antioxidant additives to lubricating oils are discussed. The synthesis of condensation products of alkylphenols and urea with formaldehyde in an acid medium is presented. Condensation products, derived from alkylphenol and a tertiary carbon atom base, appear to be highly effective antioxidizing admixtures. Antioxidizing admixtures were also obtained from the reaction of ammonia and furfurole. An addition of 0.01% to oil was found to increase stability to oxidation. E.E.B.

N65-19042# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.
SPECTROGRAPHIC ANALYSIS OF COBALT OXIDE (Co_3O_4) FOR TRACE IMPURITIES)
P. C. Ghosh and M. V. Joshi 1964 11 p refs
(AEET/SPEC/3)

A spectrographic method is developed for the determination of copper, iron, nickel, chromium, manganese, magnesium, and aluminium in cobalt oxide (Co_3O_4). Graphite powder is used as a buffer. It is mixed with the sample in the ratio of 1:1 by weight and excited in a dc arc in an atmosphere of oxygen. The method was standardized and working curves were drawn for impurity range of 2 to 250 ppm. The mean standard deviation of the method varies from 9% to 18% for different elements. Author

N65-19043# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.
SPECTROCHEMICAL DETERMINATION OF BORON IN GRAPHITE
A. P. D'Silva, T. R. Saranathan, and L. C. Chandola 1964 13 p refs Supersedes AEET/ANAL/18; See N64-15722
(AEET/SPEC/4; AEET/ANAL/18)

A spectrochemical method was worked out for the determination of boron in graphite with a detection limit of 0.05 ppm. The graphite sample is ashed in the presence of a mixture of calcium oxide and calcium sucrate at 800° C in oxygen. Fifty-milligram pellets of the resulting calcium oxide are arced in an atmosphere of argon. The standard line pair B 2497.7/Au 2428.0 gave a precision of 6.5%. The effect of large amounts of iron, silicon, chlorine, and fluorine was investigated. Author

N65-19048# California Univ., Berkeley. Lawrence Radiation Lab.
NUCLEAR CHEMISTRY DIVISION ANNUAL REPORT, 1964
I. Perlman, J. M. Hollander, F. Reynolds, and B. Cunningham, ed. Jan. 1965 297 p refs
(Contract W-7405-ENG-48)
(UCRL-11828) CFSTI: $6.00

Research was performed in the following areas: ***Radioactivity and Nuclear Structure*** (nuclear structure and pairing correlations for the heavy elements, measurements of internal conversion coefficients in the decay of U^{237} and of pair-production cross sections near threshold, etc.); ***Fission*** (fission-excitation functions in interactions of C^{12}, O^{16}, and Ne^{22} with various targets, fission barriers of polonium-210 and antimony-119, 117, etc.); ***Nuclear Reactions and Scattering*** (inelastic and elastic scattering of various nuclei, final-state interactions in the $He^3(d,t)$ 2p reaction at 24.7 and 33.4 MeV, etc.); ***Physical Chemistry*** (energy levels of 4+ actinides, etc.); ***Instrumentation*** (new type of beam integrator, silicon radiation detectors, etc.); ***Chemical Engineering*** (electromagnetic levitation of metals, etc.); and ***Thesis Abstracts*** (nuclear and magnetic resonance in S-state ions, etc.). G.G.

N65-19057# Harvard Univ., Cambridge, Mass. Cruft Lab.
STARK EFFECTS ON THE QUADRUPOLE COUPLING OF Cl^{35} IN SODIUM CHLORATE
Francis A. Collins 21 Jan. 1964 78 p refs
(Contracts Nonr-1866(16); ARPA SD-88)
(TR-435; AD-601426)

The tensor $\underline{R}^{\sigma}$ was determined for Cl^{35} in $NaClO_3$. Measured values are reported and the results interpreted as being due to several mechanisms: the direct response of the chlorate group; the polarization of the complex with respect to the magnetic field and the lattice-sum contribution; and the relation between the direction and magnitude of the field applied to the crystal and the local fields actually existing in the chlorate group. The tipping of the group, due to its electric dipole moment, is an important factor, especially above room temperature. It was concluded that the direct response of the covalently bonded chlorate group to fields and field gradients is equally as important as the solid state effects due to local field effects and the change in the lattice-sum contribution to the quadrupole coupling. E.E.B.

N65-19064# Union Carbide Corp., Parma, Ohio. Research Lab.
HIGH TEMPERATURE PROTECTIVE COATINGS FOR GRAPHITE, PART II Summary Technical Report, 1 Jun. 1963–31 May 1964
J. M. Criscione, R. A. Mercuri, E. P. Schram, A. W. Smith, and H. F. Volk Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 154 p refs
(Contract AF 33(657)-11253)
(ML-TDR-64-173, Pt. II; AD-608092)

A comprehensive program to provide fundamental information concerning various factors controlling the oxidation behavior of protective coating systems for graphite at temperatures up to 2200° C is outlined and described. Work presented includes: the evaporation of iridium in the presence of oxygen and water vapor to temperatures of 1300° C; the results of studies involving carbon diffusion through iridium; the permeability of iridium, rhodium, ZrO_2, HfO_2, and ThO_2 to oxygen at temperatures of 2000° C; the coating of graphite with iridium, including the carbon–iridium eutectic temperature determination; the reactions of iridium and rhodium with ZrB_2, HfB_2, ZrC, HfC, and ThC_2; the kinetics of the carbothermic reduction of ZrO_2, HfO_2, and ThO_2 to temperatures in excess of 2000° C; the chemical reactions of graphite with ZrB_2 and HfB_2; and arc plasma tests of iridium-coated graphite. Author

N65-19074# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINING ELEMENTARY BORON IN A GLOW DISCHARGE
L. R. Markovskiy, V. L. L'Vova, and Yu. D. Kondrashev 4 Feb. 1965 13 p refs Transl. into ENGLISH from Tr. Konf. po Khim. Bora i Ego Soyedineniy (Moscow), 1958 p 36–45
(FTD-MT-64-427; AD-611085)

Pure boron chloride and electrolytic hydrogen were passed through a glow discharge at pressures from 30 to 200 mm Hg, and developed the following characteristics: a higher ignition voltage as compared to discharge in pure hydrogen, and, the phenomenon of hysteresis when the decreasing and increasing characteristics are removed. This was connected with the continuous disposition of crystal boron on the electrodes, and highly dispersed boron on the walls of the discharge tube. The formation of boron depended upon the kinetic and electrical conditions of the process. One passage of the gas mixture through the discharge tube with hollow copper electrodes produced dispersed boron with a purity of up to 99.9% and a yield to 50% from boron chloride. The X-ray investigations established electrodischarge boron as the purest and most typical microcrystalline boron in comparison with other methods employed. G.G.

N65-19096# Peninsular ChemResearch, Inc., Gainesville, Fla. Research Div.
RESEARCH ON SELECTIVE FLUORINATION TECHNIQUES Quarterly Progress Report No. 5, 1 Nov. 1964–31 Jan. 1965
Dale A. Warner, Skevos N. Tsoukalas, and S. E. Rochow 17 Feb. 1965 22 p refs
(Contract AF 04(611)-9574; ARPA Order 24)
(Rept.-65-4; AD-457997)

The kinetics of aqueous fluorination of hydrazine, MMH, and UDMH have been studied under the conditions of limited fluorine availability. At 25° the reaction appears to be zero order in hydrazine. Author

N65-19119# General Dynamics/Fort Worth, Tex. Nuclear Aerospace Research Facility
EFFECT OF ENVIRONMENTAL HYDROGEN PRESSURE ON THE HYDROGEN YIELD FROM X-IRRADIATED POLYETHYLENES Technical Report, 1 Oct. 1963–30 Sep. 1964
O. H. Hill and R. P. Lightfoot Kirtland AFB, N. Mex., AF Weapons Lab. 15 Jan. 1965 36 p
(Contract AF 29(601)-6213)
(WL-TR-64-150; AD-611561)

An experimental assembly incorporating a capacitance-type, differential pressure transducer, which provides resolutions of 0.3 micron at pressures extending to 30 mm, was employed to monitor the effect of hydrogen environmental pressure on the hydrogen yield from X-irradiated polyethylenes. The hydrogen yield is independent of hydrogen environmental pressures extending up to at least 30 mm Hg. It is demonstrated that neglecting the temperature and density gradients inherent in closed-volume irradiation assemblies employing cryogenic traps to separate liberated gases into condensable and noncondensable fractions may lead to erroneous conclusions with respect to gas yields arising from the irradiation of materials. Total volatile G-values of 3.6, 3.8, and 4.0 molecules per 100 eV were obtained for Marlex 6002, Dow Ziegler (Q 917.5), and DuPont A-1410 polyethylenes, respectively, with hydrogen contributions of approximately 98 mole %. Author

N65-19188# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHEMISTRY OF SULPHUR ORGANIC COMPOUNDS CONTAINED IN PETROLEUM AND PETROLEUM PRODUCTS Selected Articles
12 Jan. 1965 45 p refs Transl. into ENGLISH from the publ. "Khim. Seraorganicheskikh Soyedineniy, Soderzhashch. v Neft. i Nefteprod. Akad. Nauk SSSR, Bashkirsk. Filial (USSR), v. 5, 1963 p 149–182
(FTD-MT-64-215; AD-611071)

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2. INFLUENCE OF NATURAL AND SYNTHETIC SULPHUR- AND NITROGEN-CONTAINING COMPOUNDS ON THE THERMOOXIDIZING STABILITY OF DIRECT DISTILLATION OF FUELS G. F. Bol'shakov, P. I. Davydov, T. G. Potapenko, F. Yu. Rachinskiy, and N. M. Slavachevskaya p 17–31 refs (See N65-19190 09-06)

3. INVESTIGATION OF THE THERMAL STABILITY AND CORROSIVENESS OF SULFUROUS FUELS AT TEMPERATURES ABOVE 100° C Ye. R. Tereshchenko and M. Ye. Tararyshkin p 32–41 refs (See N65-19191 09-06)

N65-19189 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF ORGANIC SULFUR COMPOUNDS ON EXPLOITATIONAL PROPERTIES OF FUEL TS-1

Ya. B. Chertkov, V. M. Shchagin, and V. N. Zrelov *In its* Chem. of Sulphur Org. Compds. Contained in Petrol. and Petrol. Prod. 12 Jan. 1965 p 1–16 (See N65-19188 09-06)

Investigation of the effects on petroleum fuels of organic sulfur compounds showed that corrosion to bronze of mercaptans, sulfides, thiophanes, and disulfides during heating to 200° to 250° C was small except for di-o-tolyldisulfide which was extremely corrosive. Sulfides, disulfides, and mercaptans were a source of significant tar formation on metals during heating of petroleum above 150° C. Thiophenes did not give tarry deposits up to 250° C. At 150° to 250° C, acyclic and cyclic sulfides, thiophanes, and disulfides were a source of significant deposits; however, in the presence of thiophenes and mercaptans, up to a concentration of 0.01% and during heating to 250° C, deposits were insignificant. E.E.B.

N65-19190 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF NATURAL AND SYNTHETIC SULPHUR- AND NITROGEN-CONTAINING COMPOUNDS ON THE THERMOOXIDIZING STABILITY OF DIRECT DISTILLATION OF FUELS

G. F. Bol'shakov, P. I. Davydov, T. G. Potapenko, F. Yu. Rachinskiy, and N. M. Slavachevskaya *In its* Chem. of Sulphur Org. Compds. Contained in Petrol. and Petrol. Prod. 12 Jan. 1965 p 17-31 refs (See N65-19188 09-06)

In an investigation of the effect which sulfur compounds have on the thermal stability of petroleum fuel, it was observed that both synthetic sulfur and nitrogen organic compounds basically lower the thermal oxidizing stability of such fuels, except for 2-phenyl-2-mercaptobutylamine, 1,2,3,4-tetrahydroquinoline, certain derivatives of ionol, and the reaction product of styrene and phenol. Also, it was observed that small concentrations of heterocyclic compounds—containing the thiol, amine, and phenyl groupings—in the tarry fraction of petroleum improved the thermal oxidizing stability of petroleum fuels. E.E.B.

N65-19191 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF THE THERMAL STABILITY AND CORROSIVENESS OF SULFUROUS FUELS AT TEMPERATURES ABOVE 100°C

Ye. R. Tereshchenko and M. Ye. Tararyshkin *In its* Chem. of Sulphur Org. Compds. Contained in Petrol. and Petrol. Prod. 12 Jan. 1965 p 32–41 refs (See N65-19188 09-06)

The corrosiveness of small concentrations of sulfur containing compounds in petroleum fuels was studied at a temperature of 150° C under static conditions in a bomb, and under dynamic conditions in apparatus simulating the operation of a fuel filter of a motor. It was observed that insoluble deposits were formed above 100° C with sedimentation in the 150° to 200° C temperature interval. These products were mainly from the oxidation of sulfur, nitrogen, and oxygen organic compounds present in the fuel. Deposits were found to decrease by a factor of 2 or 3 and corrosiveness by a factor of 10 by the hydropurification of the fuel. E.E.B.

N65-19294# Air Force Cambridge Research Labs., Bedford, Mass.

THE ION EXCHANGE PROPERTIES OF CERIUM (IV) COMPOUNDS

G. G. Rocco, J. R. Weiner, and J. P. Cali Dec. 1964 45 p refs Partially prepared at Tracerlab, Inc., Waltham, Mass.
(Contract AF 19(628)-3844)
(AFCRL-64-1018; AD-611024)

The ion exchange properties of ceric phosphate were investigated including rates of reaction, distribution coefficients of alkali metals, capacity and column behavior of some elements. Ceric oxide was shown to possess anion exchange properties in acid solution and cation exchange properties in basic solution. The two compounds have properties analogous to, but not identical with, zirconium oxide and phosphate. Cesium and barium were successfully separated on a short column of ceric phosphate at room temperature. These inorganic ion exchangers show promise of providing additional means for effecting and widening the scope of radiochemical separations, an important and necessary consideration in the radioactivation analysis, of trace elements in ultrapure materials. Author

N65-19308# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.

STUDIES OF LOW-TEMPERATURE OXIDATION REACTIONS Annual Progress Report, 1 Oct. 1963–30 Sep. 1964

L. Parts, J. T. Miller, Jr., and H. R. Du Four 8 Jan. 1965 67 p refs
(Contract Nonr-3977(00))
(APR-2; AD-609800)

The autoxidation of trimethylborane was investigated spectroscopically at 90° to 110° K. Dimethylboryl methyl peroxide was found to be the only detectable product. It is concluded that the energy of activation for the intramolecular rearrangement $(CH_3)_3B^- - O - O^+ \rightarrow (CH_3)_2BOOCH_3$ is very low (<5 kcal/mole). The reactions of nitrosonium nitrate with some unsaturated hydrocarbons were investigated at 77° to 195° K. Ethylene, propene, and propyne were found to catalyze the isomerization of nitrosonium nitrate to a colorless isomeric species, presumably symmetrical dinitrogen tetroxide, in the presence of oxygen at 77° to 90° K. Olefins that are more susceptible to electrophilic addition reactions undergo addition reactions. The reaction with isobutylene was investigated in detail by preparative vacuum line and by spectroscopic techniques. A very unstable solid, believed to be the *cis*-dimeric form of isobutylene nitrosonitrate, was isolated. The 2-nitratoisobutyraldoxime is the more readily isolatable product upon warmup to room temperature. Symmetrical dinitrogen tetroxide dissolves in isobutylene at 195° K and remains unreactive. The role of nitrosonium nitrate in reactions of N_2O_4 with olefins is discussed. A vertical-path infrared cryocell, applicable for the study of reactions in solution at temperatures above 60° K, has been placed in operation. The design and operational characteristics of the cryocell are described. Author

N65-19335# California Univ., Livermore. Lawrence Radiation Lab.

GALLIUM OXIDE, A VERSATILE COMPOUND IN SPECTROGRAPHIC PROCEDURES

W. Morris 22 Jan. 1965 13 p refs
(Contract W-7405-ENG-48)
(UCRL-7962) CFSTI: $1.00

Four methods are described that demonstrate the versatility of gallium oxide. One employs the compound as a carrier

and the other three utilize it as a collector. The relative advantages and disadvantages of using either silver chloride or gallium oxide as a carrier for the determination of traces of impurities in beryllium oxide are tabulated, and the experimental method with gallium oxide is outlined. Conditions for the determination were finally standardized and are tabulated in terms of excitation, atmosphere, electrodes, electrode charge, and exposure. The use of gallium oxide as a collector in the determinations of impurities in distilled and deionized water, in organic material, and in boron is described. Specific procedural steps are given, and the accuracies and limits of determination are given in parts per million and percent standard deviation. D.E.W.

N65-19339# Oak Ridge Inst. of Nuclear Studies, Inc., Tenn. Special Training Div.
A CHEMICAL STUDY OF AN AMBIENT TEMPERATURE CATALYTIC BENZENE SYNTHESIS USED IN RADIOCARBON DATING
J. E. Noakes, S. M. Kim, G. A. Thomas, and L. K. Akers 26 Feb. 1965 12 p refs
(ORINS-46) CFSTI: $1.00

A chemical study was made of an ambient temperature catalytic method for synthesizing liquid benzene from acetylene gas in a manner ideally suited for liquid scintillation radiocarbon dating. The benzene synthesis was studied as six specific steps with optimum conditions determined for catalyst preparation and acetylene catalysis, which has resulted in benzene yields of greater than 90%. Infrared and gas chromatographic analyses were used to check the purity of the synthesized benzene and mass spectrometry to evaluate possible chemical carbon isotope fractionation. Author

N65-19346# Aeronautical Research Labs., Melbourne (Australia).
MODERN CONCEPTS OF THE MECHANISM OF CHROMIUM DEPOSITION (A REVIEW)
N. E. Ryan Apr. 1964 25 p refs
(ARL/MET-53)

Modern concepts of the electrodeposition of chromium are reviewed. It is suggested that deposition of chromium occurs via products formed in a cathode film and not directly from the electrolyte. The variables of temperature, current density, and electrolyte composition influence the formation, composition, and resolution of the cathode film, and consequently cause variations in current efficiency and changes in the nature of the chromium deposit. An hypothesis is proposed to describe a route by which chromium from hexavalent ions is finally deposited by way of the formation of complex chromium–chromate cations. Author

N65-19350# Atomic Power Development Associates, Inc., Detroit, Mich.
APDA TECHNOLOGY LOOP Review No. 238
Apr. 1964 5 p refs
(Contract AT(11-1)-865)
(TID-20614)

The current study program is an extension of the investigations for the evaluation of inline meters designed to detect impurities in operating sodium loops. A back-to-back installation of two Rhometers is being incorporated in the extended loop facility to provide continuous differential measurement of the contaminant separations effected by the various new purification units. Supporting laboratory effort was initiated to develop analytical techniques for confirmation of indicated impurity levels. A summary of present capabilities with respect to the analysis of total carbon, carbonate carbon, oxygen and hydrogen in sodium is reported, along with the progress on the development of new methods or the improvement of existing methods. Author

N65-19358# Cincinnati Univ., Ohio. Physics Lab.
THE DETERMINATION OF CHLORINE AND IONIC CHLORIDE IN ORGANIC COMPOUNDS Technical Report, Jun.–Aug. 1964
Thomas M. Downer, Jr. Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 16 p refs
(Contract AF 33(657)-10944)
(AFML-TR-64-344; AD-609650)

A rapid method for the determination of chlorine is described. The method is applicable to the chloride ion formed following an oxygen flask combustion procedure or for soluble ionic hydrochlorides. The percentage of chloride is determined by titrating the chloride ion with silver nitrate using an adsorption indicator, 2,7-dichlorofluorescein to detect the endpoint. Compounds containing carbon, hydrogen, nitrogen, chlorine and sulfur were successfully analyzed. Author

N65-19360# Air Force Systems Command, Wright-Patterson AFB, Ohio. Materials Physics Div.
A GENERAL SPECTROCHEMICAL METHOD FOR THE DETERMINATION OF IMPURITIES IN HfO_2, TiO_2, AND ZrO_2
James H. Muntz Dec. 1964 29 p refs
(AFML-TR-64-357; AD-611006)

Analysis of many types of refractory materials made it desirable to have one method applicable to as many of these materials as possible. The method developed provides identical conditions for sample preparation, excitation, and other steps in the analysis of HfO_2, TiO_2, and ZrO_2 and compounds or materials that can be converted to the oxides. The technique involves the use of a mixed buffer–carrier, a controlled atmosphere, relatively high amperage, and a short exposure time. Conditions were selected to give optimum sensitivity for impurities with minimum spectral interference from the matrix. Determination of some of the refractory impurities such as Hf in ZrO_2, as well as the more volatile impurities is possible. Sixteen impurity elements can be determined, most of them in the 10–1000 ppm range, with an overall precision of about ±20%. Two additional impurity elements are determined semiquantitatively by visual estimation. Author

N65-19361# Perkin-Elmer Corp., Norwalk, Conn.
THE PREPARATION OF ORIENTED SINGLE CRYSTAL SPHERES OF INTERMETALLIC COMPOUNDS BETWEEN THE RARE EARTH AND IRON GROUP METALS Technical Report, Jul. 1963–Jul. 1964
James F. Nester Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 29 p refs
(Contract AF 33(657)-11282)
(AFML-TR-64-362; AD-611430)

A process was developed whereby single crystals of incongruently melting intermetallic compounds between rare earth and iron group transition elements can be grown and fabricated into small spheres. Single crystals of YCo_5, $NdCo_5$, $DyCo_5$, and "YFe_9" were grown, and spheres up to 2.67 millimeters in diameter fabricated from these materials (with the exception of $DyCo_5$). Metallographic techniques were developed for these materials, and in many cases the results differed substantially from published data. Metallographic and X-ray techniques were used to establish the single crystal character of the materials. Author

N65-19368# Princeton Univ., N. J. Frick Chemical Lab.
EFFECT OF SULFUR RANK ON THE CHEMORHEOLOGY OF CROSSLINKED POLYSULFIDE ELASTOMERS
W. J. Mac Knight, N. Canter, and A. V. Tobolsky [1964] 18 p refs
(Contract Nonr-1858(07))
(RLT-84; AD-608803)

The chemical stress relaxation of a series of 10-mole-percent cross-linked poly(ethylene polysulfides) of varying sulfur ranks is investigated. In addition, the effect of carbon black on the chemical relaxation time of lightly cross-linked disulfide polymers is discussed. It is concluded that stress decay in the elastomers studied can be well represented by a simple exponential decay law, although a sum of two exponentials fits the data somewhat better. It is also concluded that the major portion of stress decay in cross-linked polysulfides occurs by the reversible scission and bond interchange of polysulfide linkages of rank greater than two. Author

N65-19369# American Cyanamid Co., Stamford, Conn. Central Research Div.
SOLID ROCKET PROPELLANT RESEARCH AND DEVELOPMENT. VOLUME 2: COMPUTATION OF THE EQUILIBRIUM COMPOSITION OF MULTICOMPONENT CHEMICAL SYSTEMS Annual Report, 1964
Robert L. Potter 1 Feb. 1965 167 p refs
(Contract NOrd-18728; ARPA Order 22)
(AD-458524)

The multicomponent chemical equilibrium problem is discussed generally and a formulation suitable for use with digital computers is given. Some degree of detail is included in order to indicate various pitfalls that may occur and how they may be overcome. A geometric picture is supplied for a few simple cases, in order to aid in visualizing the iteration processes. The goal of this formulation is to provide a systematic method of solving the multicomponent chemical equilibrium problem with the least amount of knowledge concerning the chemistry of the system that is possible. It is stated that it appears that the objective of requiring estimates of no variables except perhaps the temperature was fairly met. D.E.W.

N65-19376# Midwest Research Inst., Kansas City, Mo.
SYNTHESIS OF ELASTOMERS CONTAINING Si-N BONDS IN THE MAIN CHAIN Quarterly Progress Report, 1 Oct.–31 Dec. 1964
Richard L. Elliott and L. W. Breed 13 Jan. 1965 19 p refs
(Contract DA-23-072-ORD-1687)
(QPR-11; AD-610030)

Methods of synthesis for new siloxazane monomers are described. Condensation of these monomers with bisphenol A produces rubbery, solid polymers with intrinsic viscosities up to 2.7. Author

N65-19381# General Motors Corp., Anderson, Ind. Delco-Remy Div.
ZINC ELECTRODE INVESTIGATION Quarterly Technical Progress Report, 1 Oct. 1964–1 Jan. 1965
J. J. Lander, J. A. Kerella, and R. S. Bogner 15 Jan. 1965 52 p
(Contract AF 33(615)-1583)
(QTPR-2; AD-609984)

Tests utilizing a catalyst indicate that the recombination of gases appears to be chiefly dependent on the quantity of catalyst present. It is apparent that internal cell pressure affects cycle life, i.e., high internal pressure reduces cycle life somewhat and low internal pressure increases life. Certain zinc crystal sizes may be detrimental to cycle life. Additional studies are to be made. The additions of various impurities to the cell, such as FeO, MnO, and K_2CO_3, do not appear to be detrimental to cycle life of the silver–zinc cell. The use of the surfactant Emulphogene (about 1%) apparently aids in the cycle life of the zinc negative plate. Higher percentages are to be tested. A new plastic styrene-based resin is to be tested in cell cases and covers. Author

N65-19384# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry
CHEMILUMINESCENT ATOM REACTIONS PERTINENT TO UPPER ATMOSPHERE STUDIES Final Report
Paul Harteck, R. R. Reeves, Jr., and E. W. Albers Sep. 1964 65 p refs
(Contract AF 19(604)-6128)
(AFCRL-64-808; AD-610710)

Surface catalyzed excitation was studied. An evaluation was made of the feasibility of utilizing the surface catalyzed excitation process to obtain direct information about the atom concentrations in the upper atmosphere. The release of many pounds of finely divided catalyst could result in an emission due to the catalytic recombination of these atoms. It appeared unlikely, however, that the emission would be observable. The catalytic production of the $O_2A^3\Sigma_u^+$ molecule was observed. Many reactions and/or interactions may take place, and it appears that the unexpected surface-catalyzed excitation process may frequently interfere with low-pressure atom reaction and emission studies. Author

N65-19393# European Atomic Energy Community, Brussels (Belgium).
QUANTITATIVE MICROPROBE ANALYSIS
D. Quataert and R. Theisen 1964 25 p refs Presented at the Electron and Ion Beam Conf., Toronto, 3–7 May 1964
(EUR-2156.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

We have attempted to set up correction formulae for local microprobe analysis. An outline is given of the various methods which can be used to allow for the atomic number effects. Author

N65-19399# Calvin Coll., Grand Rapids, Mich. Dept. of Chemistry
LOW TEMPERATURE CYCLING BEHAVIOR OF THE SILVER ELECTRODE
Thedford P. Dirkse 1 Nov. 1964 12 p refs
(Contract Nonr-1682(02))
(TR-3; AD-609876)

Work on the cycling characteristics of the silver electrode was carried out. Emphasis was placed on the performance of the silver electrode at temperatures below freezing and the effect of current density on these characteristics. Author

N65-19400# Monsanto Research Corp., Everett, Mass. Boston Lab.
CHEMILUMINESCENT SYSTEMS Technical Report No. 2
15 Dec. 1964 24 p refs
(Contract Nonr-4511(00); ARPA Order 299)
(MRB3009Q2; AD-609609)

Major emphasis was on the screening program for chemiluminescent autoxidation reactions. Weak chemiluminescence was observed for almost all base-catalyzed reactions in aprotic

solvents. The brightest visible emissions observed thus far were the oxidations of benzoin and of 2-benzylimidazoline. The luminescence of lucigenin in alkaline peroxide oxidation in mixed solvents was studied as a function of THF concentration. Within the bounds determined by product precipitation, the peak intensity, total emission "figure-of-merit", and decay rate increase with THF concentration. Striking correlation has been observed between the decay half-lives of the chemiluminescence of the lucigenin solution and of the lucigenin-free solution at the same reagent levels. Author

N65-19404# Union Carbide Nuclear Co., Paducah, Ky. Chemical Lab. Dept.
PURITY DETERMINATION OF A URANIUM METAL STANDARD
B. H. Whiteaker, J. C. Gillespie, and P. E. Dill 1 Mar. 1965 27 p refs
(Contract W-7405-ENG-26)
(KY-481) CFSTI: $2.00

High-purity uranium metal is evaluated for use as a standard sample. Samples in the form of 5-gram metal cubes were obtained from a regular high-purity production run prepared by the magnesium bomb reduction method. The purity of the metal was established by analyzing for the impurities and subtracting them from 100. A compilation of the data received resulted in a tentative purity value of 99.9865% ±0.0043%. Analyses of five elements not included in the original analysis indicated a possible additional impurity content of as much as 300 ppm. However, there is reason to believe that they should be entirely absent. Therefore, this value has been assigned to the metal and will be used as the reference standard in the resolution of analytical differences between laboratories.
Author

N65-19407# Strathclyde Univ., Glasgow (Scotland). Chemistry Dept.
[SPECTROSCOPIC STUDIES OF REACTIONS OF INORGANIC COMPOUNDS IN NON-AQUEOUS SOLVENTS] Final Technical Report, 1 Oct. 1961–30 Sep. 1964
D. W. A. Sharp and D. H. Brown [1964] 14 p refs
(Contract N62558-3061)
(AD-609712)

The work dealt with the reactions of inorganic compounds in nonaqueous solvents, and was carried out from a spectroscopic and a preparative point of view. This report deals with each aspect of the chemistry in turn. Author

N65-19408# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
AUTORADIOGRAPHY AND MATERIALS RESEARCH Technical Documentary Report, Sep. 1962–Jun. 1964
Paul L. Faust and G. William Lawless Dec. 1964 34 p refs
(ML-TDR-64-318; AD-611222)

Autoradiography is defined and discussed and the "wet-process" technique outlined. Requirements on the characteristics of the radioactivity of specimen material are noted along with a discussion of the overall resolution obtainable. Some physiological aspects of tracer level (less than 3 MeV) radioactivity are considered and some experiments are cited illustrating the use of radioactive tracers in materials research.
Author

N65-19462# National Bureau of Standards, Washington, D. C.
FLUOROCARBON POLYMERS. PERFLUOROPOLYTOLYLENES
Walter J. Pummer and Leo A. Wall Dec. 1964 25 p refs
(BuWeps Order IPR-19-62-8014-WEPS)
(NBS-8594; AD-609448)

Perfluoro-polytolylenes were prepared by treating 2-chloroheptafluorotoluene with magnesium in tetrahydrofuran. Polymerization occurred readily at 0° C. High-molecular-weight polymers were prepared by refluxing the mixture for as long as 5 days. Soluble polymers were obtained having molecular weights of 5100, 35 600, 88 500, and 200 000. These polymers exhibited good thermal stability in a vacuum to 600° C.
Author

N65-19469# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
THE DEGREE OF ACIDITY OF SOME ORGANO-PHOSPHORIC ACIDS AND ITS ASSOCIATION IN ORGANIC SOLVENTS [DER SAUREGRAD EINIGER ORGANOPHOSPHORSAUREN UND SEINE ASSOZIATION IN ORGANISCHEN LOSUNGSMITTELN]
F. Krasovec Nov. 1964 8 p refs In GERMAN Presented at IUPAC Symp. "Organo-Phosphorus Compounds", Heidelberg, 20-22 May 1964
(NIJS-R-441)

The organophosphoric acids $(RO)_2POOH$, $(RO)RPOOH$, and R_2POOH were formed, and their dissociation constant was determined in 1 M perchlorate solution. A declining acidity was found for $(RO)_2POOH > (RO)RPOOH > R_2POOH$. All organophosphoric acids underwent dimerization in $CHCl_3$ with constant values between $10^{3.22}$ and $10^{4.50}$. An increase of the dissociation constant was coupled with a decrease of the dimerization constant. The dimerization values of the acids in various organic solvents decreased with higher polarization of the solvent medium. Trans. by G.G.

N65-19471# Joint Publications Research Service, Washington, D. C.
PYROLYTIC CARBON: PRODUCTION, STRUCTURE, AND PROPERTIES
A. S. Fialkov, A. I. Baver, N. M. Sidorov, M. I. Chaykun, and S. M. Rabinovich 23 Mar. 1965 34 p refs Transl. into ENGLISH from Usp. Khim. (Moscow), v. 34, no. 1, Jan. 1965 p 132–153
(JPRS-29242; TT-65-30565) CFSTI: $2.00

A general review of pyrolytic carbon, the product of pyrolysis of hydrocarbons is given. The topics discussed are structural analysis, physicochemical processes occurring in production, methods of production, and properties of pyrolytic carbon.
R.C.S.

N65-19474# European Atomic Energy Community, Brussells (Belgium).
COMPLEX FORMATION IN TERTIARY AMINE EXTRACTION OF TRIVALENT METALS
W. Müller, J. Fuger (Inst. Interuniv. des Sci. Nucl., Brussels), and G. Duyckaerts (Liège Univ.) 1964 22 p refs Presented at the 8th Intern. Conf. on Coord. Chem., Vienna, 7–11 Sep. 1964
(EUR-2169.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 40 Belg. Fr.

The equilibria between hydrogen chloride and organic solutions of trilaurylamine were studied and the amine extraction of ferric chloride in macro- and tracer amounts was compared with the extraction of trivalent actinides and lanthanides. Complexes containing two molecules of amine salt per atom of the metal are formed either when trivalent actinides and lanthanides are extracted from concentrated chloride solutions or when trivalent iron is extracted from dilute hydrochloric

acid or lithium chloride solutions. The decrease in metal extraction at high chloride concentration and with increasing acid activity is due to competition between the extraction of the metal and the extraction of excess hydrogen chloride, the latter leading to amine dihydrochloride. It is concluded that the diluent–amine salt interaction decreases in the order chloroform, aromatic hydrocarbons, and cyclohexane. Author

N65-19482# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.

A BIBLIOGRAPHY ON SELECTED PROPERTIES OF THE SODIUM, POTASSIUM, AND RUBIDIUM NITRATES, CHLORATES, AND BROMATES

Saul Krasner and Peter D. Townsend Oct. 1964 30 p refs
(PA-TR-3161; AD-452319)

This bibliography contains references on the nitrates, chlorates, and bromates of sodium, potassium, and rubidium with particular emphasis on the following subjects: crystal growth, thermal decomposition, electron spin resonance, magnetic and optical properties, and radiation damage. Author

N65-19516# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.

SPECTROGRAPHIC DETERMINATION OF TRACE IMPURITIES IN FERRIC OXIDE

P. C. Ghosh and R. Venkatasubramanian 1964 12 p refs
(AEET-SPEC-5)

A spectrographic method was developed for the determination of aluminum, copper, cobalt, indium, lead, and manganese in ferric oxide. The ferric oxide powder is mixed with graphite powder, which acts as a buffer, in the ratio of 1:2 by weight and excited in a dc arc. The Fe lines of the matrix are taken as internal standard lines. The elements analyzed and their concentration levels are aluminum, 5 to 50 ppm; copper, 2 to 20 ppm; cobalt, 10 to 200 ppm; indium, 10 to 100 ppm; lead, 20 to 200 ppm; and manganese, 5 to 50 ppm. The mean standard deviation of the method for the various impurities ranged between 13% and 16%. Author

N65-19517# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.

SPECTROGRAPHIC DETERMINATION OF Ce, Pr AND Nd in La_2O_3

S. S. Grampurohit, P. Sreeramamurthy, and T. R. Saranathan 1964 11 p refs
(AEET-SPEC-6)

An emission spectrographic method was developed to determine Ce, Pr, and Nd in pure lanthanum oxide. The concentration ranges covered are Ce 0.01% to 0.1%; Pr 0.0025% to 0.1%; and Nd 0.005% to 0.1%. Of the sample, 15 mgs are taken in a 1/4-in. spec-tech graphite anode and arced against a 3/16-in. spec-tech graphite cathode at a current of 10 amps. The spectra are photographed on a 3.4-meter spectrograph using a 30 000 lines/inch plane grating in the first order. The analytical lines of Ce, Pr, and Nd are 4222.60 Å, 4225.33 Å, and 4303.57 Å, respectively. Lanthanum line at 4221.23 Å is used as the internal standard line. Author

N65-19518# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.

SPECTROGRAPHIC DETERMINATION OF La, Pr, Nd and Sm IN CeO_2

P. Sreeramamurty and I. J. Machade 1964 13 p refs
(AEET-SPEC-7)

An emission spectrographic method employing dc arc excitation was developed to determine La, Pr, Nd, and Sm in pure cerium oxide. The concentration ranges covered are La 0.01% to 0.5%; Pr 0.05% to 0.5%; Nd 0.01% to 0.5%; and Sm 0.01% to 0.5%. The sample is mixed with graphite powder in the ratio 1:1 by weight, and 15 mgs of the mixture are taken in a 1/4-in. graphite anode and arced at a current of 10 amps. The spectra are photographed on a 3.4-meter spectrograph using the 30 000 lines/inch plane grating in the first order. Line pairs were used in the analysis. Author

N65-19523# Brandeis Univ., Waltham, Mass. Dept. of Chemistry

ON THE COMPOSITION OF DILUTE ALKALI METAL–AMMONIA SOLUTIONS

Sidney Golden, Charles Guttman, and Thomas R. Tuttle, Jr. 25 Nov. 1964 62 p refs
(Contract Nonr-1677(01))
(TR-13; AD-609578)

Dilute solutions of the alkali metals in liquid ammonia are assumed to consist of the following constituents: M^+, the solvated metal cation; S, the solvent; M^-, the solvated metal anion; S^-, the solvent anion (solvated electron); the ion-pairs M^+M^- and M^+S^-. These species are assumed to be in equilibrium via

$$M^+ + 2S^- \rightleftarrows M^- + 2S$$

and

$$M^+ + A^- \rightleftarrows M^+A^-,$$

where A^- is either M^- or S^-. For simplicity, the activity coefficient of each species is assumed to be given by the extended theory of Debye and Hückel, with a fixed value of 5.5 Å for the interionic size parameter; the ion-pairing theory of Fuoss, with the same value for the interionic size parameter, is also assumed. The only adjustable parameter then remaining for a complete characterization of the composition of dilute alkali metal–ammonia solutions is the redox equilibrium constant. Author

N65-19531# Air Force Office of Scientific Research, Washington, D. C.

[ANALYTICAL METHODS AND TECHNIQUES; STRUCTURES OF INORGANIC COMPOUNDS, REACTION MECHANISMS AND KINETICS] Chemistry Program Review, Fiscal Year 1964

Alfred Weissler, Milton D. Sprinkel, and Orville Rollins, ed. Nov. 1964 190 p refs
(AFOSR-64-1872; AD-609875)

Items of special interest described in terms understandable to the nonspecialist, scientific reports received during the year, active projects, and concise factual summaries, including administrative data as well as research accomplishments, are presented. Major divisions of the review are aerospace chemistry, inorganic chemistry, chemical reactivity and mechanisms, methods and techniques, symposia, and chemistry program statistics. E.E.B.

N65-19566# European Atomic Energy Community, Brussels (Belgium).

WATER DETERMINATION IN TERPHENYLS USING THE KARL FISCHER COULOMETRIC TITRATION

R. Veneroni and R. Friesen 1964 51 p refs
(EUR-2159.e) Available from the Belg. Am. Bank and Trust Co., New York Account No. 22.186: 60 Belg. Fr.

The development of a discontinuous method for the determination of water in terphenyl during static autoclave corrosion tests is reported. The method is especially useful for relatively small samples and low water concentrations. Samples are collected in glass vials. A correction can generally be made if interfering compounds are present in the terphenyl. In the usual range of 10–100 ppm the standard deviation is about 3 ppm. Author

N65-19590# General Dynamics/Fort Worth, Tex.
X-RADIATION-INDUCED UNSATURATION CHANGES IN MARLEX 6002 POLYETHYLENE Technical Report, 1 Oct. 1963–30 Sep. 1964
O. H. Hill and T. W. Albrecht Kirtland AFB, N. Mex., AF Weapons Lab., 15 Jan. 1965 41 p refs
(Contract AF 29(601)-6213)
(FZK-204; WL-TR-64-147; AD-611575)

An irradiation-dewar assembly was designed for use with an infrared spectrophotometer so that selected organics can be intermittently monitored during X-irradiation with maximum environmental and temperature integrity of the sample. This assembly was used to study the temperature dependence of the rates of change of unsaturation in Marlex 6002 polyethylene. Since extinction coefficient data, based upon the application of wet-chemistry techniques, are restricted to room temperature measurements, the additional data required to establish the effective temperature dependence of this parameter were also developed. The initial rate of radiation-induced transvinylene formation in Marlex 6002 polyethylene is found to be 2.0±0.3 bonds per 100 eV and independent of temperature over the range of from 105° to 300° K, while vinyl decay extrapolated to zero radiation dose over the same range satisfies $G(-Vi) = 5.8 \exp[341\,(1/300 - 1/T)]$, with $G(-Vi)$ representing the number of vinyl bonds disappearing per 100 eV absorbed at absolute temperature T(° K). Author

N65-19597# Hughes Aircraft Co., Culver City, Calif. Electronic Properties Information Center
GERMANIUM Data Sheets
M. Neuberger Wright-Patterson AFB, Ohio, Res. and Technol. Div., Feb. 1965 241 p refs
(Contract AF 33(615)-1235)
(DS-143; AD-610828)

These data sheets present a compilation of a wide range of electrical, optical and energy values for pure and variously doped germanium in bulk and film form. Electrical properties include conductivity, resistivity, dielectric constant, Hall coefficient, mobility, lifetime, thermoelectric and thermomagnetic effects. Emission data were broken down into the varied electron and photon emissions which result from application of energy in the electromagnetic spectrum. Energy data include energy bands, energy gap and energy levels for variously doped germanium as well as effective mass tables, work function, carrier diffusion and cross sections. The optical properties include absorption, reflection and refractive index. Other magnetic data and irradiation effects are included, as well as several bordering physical phenomena. Each property is compiled over the widest possible range of parameters from references obtained in a thorough literature search. Author

N65-19599# General Electric Co., Schenectady, N. Y. Research Lab.
RESEARCH ON CdTe Quarterly Report
R. E. Halstead, D. T. F. Marple, and B. Segall Wright-Patterson AFB, Ohio, Aerospace Res. Labs., 31 Jan 1965 14 p refs
(Contract AF 33(616)-8264)
(QPR-14; AD-611168)

The attempt to obtain the best possible fit of the CdTe data with the theory of indirect interband and indirect exciton absorption is reported. Also, a theoretical study of the band edge in CdTe is summarized. It was found that a quantitative fit of the experimental data could be provided by a mechanism involving the creation of a direct exciton simultaneously with the absorption of one or two longitudinal-optical phonons. The initial data on optical transmission to 500μ at 4° K exhibit detail which merit investigation. The Gunn effect in CdTe is discussed as offering some promise for the conversion of dc to rf in the Gc/sec range. E.E.B.

N65-19600# Oak Ridge National Lab., Tenn. Isotopes Development Center
ELECTROMAGNETIC SEPARATION AND CHEMICAL REFINEMENT OF OSMIUM ISOTOPES
R. L. Johnson, C. W. Sheridan, W. A. Bell, Jr., C. V. Ketron, L. O. Love et al Mar. 1965 27 p refs
(Contract W-7405-ENG-26)
(ORNL-3770) CFSTI: $2.00

Laboratory experiments verified that OsO_4 was sufficiently stable for use as feed material in an electromagnetic isotope separation and that the reactivity of osmium metal with air was slow enough to permit recovery of enriched isotopic material. Equipment modifications partially offset the low rate of separation imposed by restrictions and controls adopted to assure the personal safety of those working with volatile and toxic OsO_4. Chemical recovery and refinement were achieved by trapping OsO_4 in hydrobromic acid, precipitating hydrated OsO_2, and reducing to the metal with hydrogen. More than 39 g of enriched osmium isotopes was made available for research programs. Author

N65-19604# France. Ministere de l'Air, Paris.
PRODUCTION OF THREADLIKE JETS OF IONIZED GASES AND APPLICATION TO THE PASSAGE OF VERY STRONG DENSITY CURRENTS [PRODUCTION DE JETS FILIFORMES DE GAZ IONISES ET APPLICATION AU PASSAGE DE TRES FORTES DENSITES DE COURANT]
Maurice Skowronek Serv. de Doc. Sci. et Tech. de l'Armement, 1964 107 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 409

In studies of the electric discharge emitted by a fine point (diameter ~ 0.5μ), an ionized stream (diameter < 10μ) whose current density is above 10^3 A/cm^2 was observed in the neighborhood of the point. The ionized stream was used to discharge a battery of condensers with the following results: maximum stored energy, 18 kJ; period, 10 μsec; and maximum current, 250 kA. The electronic density exceeds 7×10^{17} cm^{-2}. The expansion of the stream occurs in a cylindrical manner, and a shock wave propagates to Mach 12 in an air atmosphere. A precursor signal is also observed. The upper limit of the temperature at the midline, calculated according to Braginskii's theory, is 2×10^5 °K, whereas the temperature calculated according to Haines' theory is 2.7×10^8 °K.
Transl. by M.P.G.

N65-19611# Sheffield Univ. (England). Dept. of Chemistry
DECAY OF THE TRIPLET STATE Final Technical Report
G. Porter and J. W. Hilpern 30 Sep. 1964 41 p refs
(Grant AF-EOAR-61(052)-722)
(AFCRL-64-1017; AD-610783)

CONTENTS:

1. DECAY OF 9, 10-HALOGEN SUBSTITUTED ANTHRACENES IN THE TRIPLET STATE 11 p refs (See N65-19612 09-06)

2. AN OBSERVATION OF ANOMALOUS FLUORESCENCE OF BIPHENYLENE AND CALCULATIONS ON THE ELECTRONIC SPECTRUM 28 p refs (See N65-19613 09-06)

N65-19612 Sheffield Univ. (England) Dept. of Chemistry
DECAY OF 9,10-HALOGEN SUBSTITUTED ANTHRACENES IN THE TRIPLET STATE
In its Decay of the Triplet State 30 Sep. 1964 11 p refs (See N65-19611 09-06)

Examination of the triplet lifetime of 9,10 halogen substituted anthracenes over a large range of temperatures and viscosity has shown that 9,10-bromo substitution only slightly affects the lifetime, whereas 9,10-chloro substitution has a greater heavy atom effect, comparable with substitution in other positions of anthracene. A tentative explanation associated with the greater mesomeric effect of the chlorine atom is given. The possibility that decomposition occurs, even during the first flash in rigid media at low temperatures cannot, however, yet be completely excluded. Author

N65-19613 Sheffield Univ. (England). Dept. of Chemistry
AN OBSERVATION OF ANOMALOUS FLUORESCENCE OF BIPHENYLENE AND CALCULATIONS ON THE ELECTRONIC SPECTRUM
In its Decay of the Triplet State 30 Sep. 1964 28 p refs (See N65-19611 09-06)

The phosphorescent and fluorescent emission spectra and triplet–triplet absorption spectrum of biphenylene were measured. A Pariser–Parr–Pople calculation was carried out on the electronic bands of biphenylene. Phosphorescence and fluorescence are seen to occur from the second electronic bands, probably due to the operation of $u \leftrightarrow u$, $u \nleftrightarrow g$, radiationless selection rules. The electronic levels of biphenylene are assigned. Author

N65-19628# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy
DETERMINATION OF X-RAY SCATTERING FACTORS WITH LIQUID SPECIMENS Technical Report No. 5
Roy Kaplow, S. L. Strong, and B. L. Averbach 3 Nov. 1964 11 p refs
(Contract Nonr-1841(48))
(DSR-7954; AD-609603)

An analysis is described for obtaining X-ray scattering factors from intensity measurements on liquid specimens. Experimental results for the shape of the scattering factor curves for lead, mercury, and tin are compared to Thomas–Fermi–Dirac, Hartree–Fock–Slater, Hartree–Fock, Hartree (self-consistent field), and relativistic calculations. Author

N65-19630# Rochester Univ., N. Y. Dept. of Chemical Engineering
INFRARED SPECTRA OF METAPHOSPHATE GLASSES
Gouq-Jen Su and Chi-kai Shih Dec. 1964 71 p refs
(Contract Nonr-668(19))
(TR-1; AD-609606)

The infrared transmission spectra of binary alkali or alkaline-earth metaphosphate glasses were determined. The glass systems include $Li_2O \cdot P_2O_5$, $Na_2O \cdot P_2O_5$, $K_2O \cdot P_2O_5$, $Rb_2O \cdot P_2O_5$, $CaO \cdot P_2O_5$, $SrO \cdot P_2O_5$, $BaO \cdot P_2O_5$, and the devitrified $K_2O \cdot P_2O_5$. The $K_2O \cdot P_2O_5$ glass and its devitrified modification were studied in the wavelength 2 to 15 microns and 2 to 25 microns, respectively. The measurements of the rest of the systems were carried out from 2 to 200 microns. The infrared spectra of the metaphosphates were measured for the first time in the wavelength region of 15 to 200 microns. Thin-film samples were used in obtaining the infrared spectra. Three sampling techniques, namely, the thin film, the KBr-pellet, and the reflection have been compared by their infrared spectra in the wavelength 2 to 15 microns. The results are identical, indicating the validity of the thin-film sampling technique. Studies were made on the possible reorientation of the structure of $Na_2O \cdot P_2O_5$ glass prepared by extended period of melting, blowing into films, and drawing into fibers. The results indicate that no change in the structure of the glass detectable by the infrared spectrum was introduced. Author

N65-19644# Atomic Energy Commission, New Brunswick, N. J.
SEMIANNUAL PROGRESS REPORT FOR THE PERIOD JANUARY 1964 THROUGH JUNE 1964
C. J. Rodden Mar. 1965 108 p refs
(NBL-216) CFSTI: $4.00

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1. A SODIUM CARBONATE FUSION-ION EXCHANGE METHOD FOR CONVERTING BORON SAMPLES TO SODIUM TETRABORATE FOR ISOTOPIC ANALYSIS A. R. Eberle and M. W. Lerner p 5–6 ref

2. BORON SCRAP RECOVERY A. R. Eberle, L. J. Pionto, and M. W. Lerner p 7 ref

3. EVALUATION OF THE METHODS IN TID-7029: "SELECTED MEASUREMENT METHODS FOR PLUTONIUM AND URANIUM IN THE NUCLEAR FUEL CYCLE": A PROGRESS REPORT M. W. Lerner p 9–10

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5. A RAPID METHOD FOR THE DETERMINATION OF URANIUM IN ROCKS AND SOILS L. C. Nelson, Jr. and H. Bussell p 13–14 refs

6. THE PROPERTIES OF A CHERENKOV COUNTER IN THE MEASUREMENT OF NITROGEN-16 ACTIVITY H. Bussell, L. C. Nelson, Jr., and C. L. Zyskowski p 15–25 refs

7. THE DETERMINATION OF BORON-10 BY SUPPRESSION OF NEUTRON ACTIVATION OF URANIUM H. Bussell p 27 refs

8. DETERMINING THE LINEARITY OF HIGH MEGOHM INPUT RESISTORS TO VIBRATING REED ELECTROMETERS BY USE OF A CONSTANT CURRENT SUPPLY J. J. Pucilowski, Jr. and H. O. Finley p 29–38 ref

9. MASS SPECTROMETRIC COMPARATIVE STUDY USING NATIONAL BUREAU OF STANDARDS URANIUM STANDARDS W. F. King and H. O. Finley p 39–49 refs

10. INSTRUMENTATION AND CALIBRATION OF A TANDEM 90° MASS SPECTROMETER L. J. Jasper, Jr. and H. O. Finley p 51–76 refs

11. MASS SPECTROMETRIC DETERMINATION OF ISOTOPIC AND TOTAL URANIUM-PLUTONIUM CONCENTRATION BY ISOTOPIC DILUTION L. J. Jasper, Jr., E. E. Leueng, Jr., L. Branovich, and H. O. Finley p 77–88 refs

12. SEPARATION OF URANIUM AND PLUTONIUM IN REACTOR FUEL ELEMENT SOLUTIONS FOR MASS SPECTROMETRIC ISOTOPIC ANALYSIS AND TOTAL ELEMENT DETERMINATION C. E. Pietri and A. W. Wenzel p 89–94 refs

13. PLUTONIUM METAL DENSITY MEASUREMENTS A. W. Wenzel and C. E. Pietri p 95–99 refs

14. A COMPARISON OF WEIGHINGS MADE WITH ANALYTICAL BALANCES IN GLOVED BOX AND CONVENTIONAL ENVIRONMENTS C. E. Pietri p 101–103

15. DETERMINATION OF TRACE AMOUNTS OF BORON IN PLUTONIUM AND URANIUM A. W. Wenzel and C. E. Pietri p 105–107 refs

16. OBSERVATIONS ON THE USE OF DIPHENYLAMINE SULFONATE INDICATOR IN POTASSIUM DICHROMATE TITRATIONS C. G. Goldbeck p 109–112 refs

N65-19659# California Univ., Livermore. Lawrence Radiation Lab.

PREPARATION AND PROPERTIES OF FLUOROCARBON ALCOHOL 3,5-DINITROBENZOATES FOR STUDY AS SURFACE ACTIVE AGENTS

Eugene R. Bissell 21 Dec. 1964 11 p refs
(Contract W-7405-ENG-48)
(UCRL-12307) CFSTI: $1.00

Variations in pressability and physical properties observed for certain types of plastic-bonded explosives (PBX) have prompted an examination of the variables involved in the slurry coating technique used to prepare PBX moulding powders. Esters of 3,5-dinitrobenzoic acid with monohydric fluorocarbon alcohols were studied. Fluorocarbon alcohol 3,5-dinitrobenzoates listed were prepared by pyridine catalyzed esterification of the corresponding alcohol with 3,5-dinitro benzoyl chloride. A detailed procedure is given for the preparation of C_5 alcohol. Results show that the esters are soluble in varying degrees in aromatic hydrocarbons. Solvents tested were benzene, and oxygenated organics such as ethanol, diethyl ether, tetrahydrofuran, ethyl acetate acetone, methyl isobutyl ketone, and dioxane. Infrared spectra taken in potassium bromine pellets showed all of the expected bands. R.C.S.

N65-19666# Atomic Energy of Canada, Ltd., Chalk River (Ontario).

DETERMINATION OF WATER IN ORGANIC COOLANT

G. R. Matteau and R. W. Ashley Jan. 1965 17 p ref
(DCI-52; AECL-2164) Available from Atomic Energy of Canada, Chalk River: $0.50

A method for the determination of water in organic coolant is described. Water is extracted with chloroform by an azeotropic distillation and titrated using a Beckman KF-3 Aquameter. The precision and accuracy of the method are ±1% (relative) for 1.5 mg or more of water. Author

N65-19715*# National Bureau of Standards, Washington, D. C.

MATRIX ISOLATION STUDY OF THE REACTION OF F ATOMS WITH CO. INFRARED AND ULTRAVIOLET SPECTRUM OF THE FREE RADICAL FCO.

Dolphus E. Milligan, Marilyn E. Jacox, Arnold M. Bass, John J. Comeford, and David E. Mann 13 Nov. 1964 37 p refs
(NASA Order R-64)
(NASA-CR-59935) CFSTI: HC $2.00/MF $0.50

FCO was obtained in a CO and in an Ar matrix at 14° to 20° K by reaction with CO of F atoms produced upon photolysis of OF_2 or of $t\text{-}N_2F_2$, as well as by the photolysis of F_2CO or of HFCO. The three vibrational fundamentals of the free radical FCO appear at 1855, 1018, and 626 cm^{-1}. Experiments employing $^{13}C^{16}O$ and $^{12}C^{18}O$ confirm the infrared identification of FCO. In ultraviolet absorption studies on matrix-isolated FCO an extensive series of bands was observed between 2200 and 3400 A. The most prominent progression in this system involves bands spaced at approximately 650 cm^{-1} intervals. It is likely that this progression is associated with the upper state bending mode of FCO. The F_2CO and $(FCO)_2$ are also produced in the reaction of F atoms with a CO matrix, and features of their infrared spectra are reported. A supplementary observation of the ultraviolet absorption spectrum of gaseous F_2CO shows a band system between 1800 and 2100 Å, with spacings of approximately 1700 cm^{-1}. Author

N65-19720*# Rensselaer Polytechnic Inst., Troy, N. Y. NASA Interdisciplinary Materials Research Center

THE CRYSTAL AND MOLECULAR STRUCTURE OF RUTHENIUM-SULFUR DIOXIDE COORDINATION COMPOUNDS. I: CHLOROTETRAAMMINE(SULFUR DIOXIDE)-RUTHENIUM(II) CHLORIDE

Lester H. Vogt, Jr., J. Lawrence Katz, and Stephen E. Wiberley [1965] 22 p refs Submitted for Publication
(Grant NsG-100)
(NASA-CR-60360) CFSTI: HC $1.00/MF $0.50

Chemical bonding in a representative ruthenium–ammine complex, $[Ru(NH_3)_4(SO_2)Cl]Cl$, is described on the basis of a three-dimensional crystal structure analysis. A narrative of the crystal complex preparation and crystal study is given. It was discovered that the SO_2 ligand is coordinated through the sulfur, and that the S–O bond lengths and the O–S–O bond angle are approximately the same as in free solid SO_2. The N, Cl, and S bonds to the ruthenium were investigated, and interval estimates of their interatomic distances and the angles are presented. J.M.D.

N65-19721*# Rensselaer Polytechnic Inst., Troy, N. Y. NASA Interdisciplinary Materials Research Center

X-RAY AND INFRARED STUDIES OF SEVERAL RUTHENIUM–SULFUR DIOXIDE COMPLEXES

Lester H. Vogt, Jr., J. Lawrence Katz, and Stephen E. Wiberley [1965] 6 p refs
(Grant NsG-100)
(NASA-CR-60358) CFSTI: HC $1.00/MF $0.50

The infrared and X-ray powder data for several $Ru\text{-}SO_2$ complexes were interpreted on the basis of crystal and molecular structure of the $Ru[(NH_3)_4(SO_2)Cl]Cl$ complex. Three similar complexes were investigated—the dichloride, dibromide, and bromo–bromide. From the examination of the X-ray powder patterns of the complexes and the infrared spectra, it was concluded that the crystal and molecular structure of the bromo–bromide and chloro–chloride complexes are completely analogous. The dichloride and dibromide complexes have crystal structures which differ both one from the other and from that of the chloro–chloride complex. However, the similarity of the infrared spectra of the former two complexes to the latter indicates that the SO_2 ligand is coordinated in the same way in all of the complexes—through the sulfur. E.E.B.

N65-19737# National Research Corp., Cambridge, Mass. Research Div.

THERMOCHEMISTRY OF SELECTED COMPOUNDS Annual Summary Report, 15 Nov. 1963–14 Nov. 1964

Ludwig G. Fasolino 9 Dec. 1964 13 p refs
(Contract Nonr-3608(00))
(AD-608999)

From measurements of the heats of solution of B_2O_3 (amorphous), B_2O_3 (crystalline), and H_3BO_3 and BCl_3 (liquid), the heats of formation were calculated for B_2O_3 (both forms) and BCl_3 (liquid). Also, attempts were made to determine a satisfactory reaction involving aluminum borohydride, the thermochemical results of which would allow a calculation of its heat of formation. A promising solution to this problem appears to be in the elevated temperature (40° C) hydrolysis of this compound. Author

N65-19743# Aeronautical Research Labs., Melbourne (Australia).

THE RATES OF SOLUTION OF CUPROUS AND CUPRIC OXIDES

L. Wilson Apr. 1964 24 p refs

(ARL/MET-19)

Atomic absorption spectroscopy has been used to determine the rates of solution of cuprous and cupric oxides in various solutions. These rates are shown to be affected by variation in pH, the type of anion present, and the valency state of the oxide. Author

N65-19809# Union Carbide Nuclear Co., Oak Ridge, Tenn. Chemical Development Dept.

KINETICS AND MECHANISM OF THE FLUORINATION OF COPPER (I) OXIDE AND COPPER (II) OXIDE

Robert Lucien Ritter 29 Mar. 1965 249 p refs

(Contract W-7405-ENG-26)

(K-1627) CFSTI: $6.00

The reaction of fluorine with copper(II) oxide took place by a diffusion controlled mechanism at temperatures between 82° and 151° C. and at fluorine pressures between 40 and 80 mm Hg. The data obeyed the kinetic law given by the equation

$$-\frac{dN_R}{} = \frac{k_P 4\pi r_R r_T}{r_T - r_R}$$

where N_R is the moles of solid reactant, t is the time, k_P is the rate constant, r_R is the radius of the solid reactant particle, r_T is the total radius of the solid particle, and $r_T - r_R$ is the thickness of the film of copper(II) fluoride. The activation energy for the reaction was 16.3 kilocalories per mole. In the pressure range investigated, the reaction rate was proportional to the square root of the fluorine pressure. The reaction of fluorine with copper(I) oxide occurred through a two-step mechanism given by the reactions

$$Cu_2O + F_2 \rightarrow CuF_2 + CuO$$

$$CuO + F_2 \rightarrow CuF_2 + 1/2O_2.$$

It was shown that the initial reaction in this two-step mechanism probably exhibits linear reaction kinetics in the temperature range of 152° to 207° C. and at fluorine pressures between 50 and 800 mm Hg. The activation energy for the reaction was 19.7 kilocalories per mole. In the pressure range investigated, the reaction rate was proportional to the 0.63 power of the fluorine pressure. Possible reaction mechanisms are presented to explain the observed pressure dependence of the reaction rate. Author

N65-19811# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.

CHEMICAL PROCESSING TECHNOLOGY QUARTERLY PROGRESS REPORT, APRIL–JUNE 1964

D. R. de Boisblanc, J. A. Mc Bride, and J. A. Buckham Jan. 1965 40 p refs

(Contract AT(10-1)-205)

(IDO-14646) CFSTI: $2.00

A flowsheet for a modified zirconium processing facility utilizing boric acid as a nuclear poison is presented. The use of cadmium as a nuclear poison in nitric acid dissolver solution was found superior to that of boric acid. Large quantities of actual HTRE-3 fuel elements and APPR fuel plates underwent electrolytic dissolution. A new titanium dissolver with the vessel itself serving as a cathode proved successful. The calcination of zirconium–aluminum–fluoride wastes from hydrofluoric acid processes for zirconium-based fuels was successful and the fluoride was retained as CaF_2 in the calcine product. Studies indicated that alumina calcine deposits yield to nitric acid decontamination and that phosphate glasses from calcined alumina were blackened, but unaffected, by gamma irradiation to 10^{10}R. Strontium and cesium radioisotopes were removed from storage water by a clinoptilolite adsorption unit. Additional aluminum nitrate–nitric acid solubility data for the freeze-melt separation process were obtained, and the relationship between analog simulation and a simplified mathematical analysis of an air pulser operation was studied. G.G.

N65-19824# Atomic Energy Commision, Oak Ridge, Tenn. Production Div.

DETAILED LISTING OF BASE CHARGES FOR U-235 ENRICHED AND DEPLETED URANIUM AS UF_6

Sep. 1964 54 p

(TID-21015) CFSTI: $3.00

This report lists the base charges currently in effect for U-235 enriched and depleted uranium as UF_6. Charges are listed for each 0.0001 weight fraction U-235 beginning with an assay (weight fraction U-235) of 0.0038 and going through 0.98. Author

N65-19826# Los Alamos Scientific Lab., N. Mex.

THE RADIOCHEMICAL PURIFICATION OF EUROPIUM AND A STUDY OF THE NUCLEAR PROPERTIES OF Eu^{157}, Eu^{158} AND Eu^{159}

W. R. Daniels (Ph. D. Thesis - N. Mex. Univ.) 7 Aug. 1964 168 p refs

(Contract W-7405-ENG-36)

(LAMS-3104)

The rapid preparation of radiochemically pure europium sources from rare-earth mixtures and from fission products by the use of mixtures of the mono- and di[p(1,1,3,3,tetramethylbutyl)phenyl]esters of orthophosphoric acid is announced. The esters are used to extract the rare earths in the (III) oxidation state away from the europium in the (II) oxidation state. Europium sources can be prepared in about 30 minutes. Also, di(2-ethylhexl) orthophosphoric acid separation of europium from yttrium is reported. Europium is separated from other rare earths by elution from a cation column with ammonium α-hydroxyisobutyrate. The study of Eu^{157}, Eu^{158}, and Eu^{159} by beta-ray and gamma-ray spectrometry; the half-lives of five europium and gadolinium nuclides from beta decay measurements; the mass assignments for 15.16 hour Eu^{157}, 45.7-minute Eu^{158}, and 17.9-minute Eu^{159} confirmation; and the search for the existence of isomeric states of Eu^{158}, Eu^{159}, and Eu^{160} are included. E.E.B.

N65-19875*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Materials Sciences Lab.

ELECTROLYTIC PREPARATION OF HIGH DIELECTRIC THIN FILMS Quarterly Report, 4 Nov. 1964–3 Feb. 1965

A. E. Hultquist and M. E. Sibert 8 Feb. 1965 18 p refs

(Contract NASw-969)

(NASA-CR-57483; LMSC-A034389) CFSTI: HC $1.00/MF $0.50

This report on the preparation of high dielectric films by electrolytic techniques is concerned with film preparation and some properties of the films. It has been shown that the EDTA bath is a useful technique for incorporating alkali metal atoms in an anodic film on titanium. There is some indication that a heat treatment of the film will provide an increased dielectric strength. The hydrolyzed isopropyl titanate bath has been

shown to produce a crystalline titania under appropriate conditions. However, cohesion and adhesion of the titania to any substrate are not yet entirely satisfactory. The KOH–$BaTiO_3$ bath does definitely deposit $BaTiO_3$ in the anodic film. However, due to the complex nature of this film, the electrical characteristics are other than desired and the film is quite sensitive to moisture. Author

N65-19895*# Miami Univ., Coral Gables, Fla.
[INVESTIGATIONS IN SPACE-RELATED BIOLOGY, INCLUDING MOLECULAR EVOLUTION AND RELEVANT ASPECTS OF THE EXTRA-TERRESTRIAL ENVIRONMENT] Semiannual Status Report, 1 Jun.–30 Nov. 1964
S. W. Fox et al [1965] 5 p
(Grant NsG-689)
(NASA-CR-57423) CFSTI: HC $1.00/MF $0.50

Analysis of volcanic sinter samples from Hawaii showed 12 to 14 polymerized amino acids but no bacteria. Fractionation of thermal proteinoids on columns revealed a limited degree of heterogeneity. The absence of lysine proteinoid catalytic activity infers interactions of other amino acids in the macromolecule. Hemin of hemoglobulin showed tryptophan pyrrolase activity at a level of about 1/2000 of that of the natural whole enzyme. Approximately 25 to 40 attributes imputed to living systems have been tabulated and show approximately 20 positive protein test attributes. Nutritional tests of thermal proteinoids and Leuchs proteinoids with *Tetrahymens pyroformis* indicate that some Leuchs proteinoids are superior to casein in feeding *Tetrahymena*. Direct optical resolution of DL-aspartic acid through optically active amine showed 95% to 100% optical impurities of the resolved aspartic acid. Pyrolytic decomposition of ammonium formate and formamide resulted in the formation of α-amino acids. Trypsin prevented the fusion of gametes to form the zygote. Electron microscopical information on sperm–egg interactions in crustacea, and electrophoretic migration of sea urchins fertilizing on cellulose acetate were obtained. G.G.

N65-19943# Space Technology Labs., Inc., Redondo Beach, Calif.
BERYLLIUM STUDY PROGRAM Second Quarterly Progress Report, 1 Jan.–31 Mar. 1964
J. L. Blumenthal and Myrrl Santy 14 Apr. 1964 71 p refs
Prepared under subcontract for Sandia Corp.
(Contract AT(29-1)-789)
(STL-4132-6002-RU000)

Reaction kinetics studies were continued, and investigations of the reactions of beryllium with nitrogen, air, and carbon monoxide in the temperature range from 1000° to 1500° C were completed. The effect of temperature, pressure, and surface coverage on the reaction kinetics was investigated. At temperatures below its melting point (1284° C) the reaction of beryllium with carbon monoxide is as much as 40 times faster than its reactions with oxygen and nitrogen. On the other hand, above the beryllium melting point, the oxygen reaction rate is faster than the nitrogen, air, or carbon monoxide reaction rates. The reaction of beryllium with dry air, above the melting point, was found to be very similar to the beryllium–nitrogen reaction. Microscopic studies of the combustion products formed from beryllium reactions with oxygen, nitrogen, and carbon monoxide indicated that in all three cases products of airborne particle size (< 10 microns) were formed. Thermochemical calculations of the theoretical flame temperatures and equilibrium compositions of methane–oxygen, hydrogen–oxygen, and acetylene–oxygen flames were carried out. Author

N65-19978# American Science and Engineering, Inc., Cambridge, Mass.
INVESTIGATION OF GROWTH OF ELECTROMAGNETIC SINGLE CRYSTALS Final Report
Carolus M. Cobb, Joseph A. Adamski, and Elbridge B. Wallis 26 Dec. 1964 117 p refs
(Contract AF 19(628)-3878)
(ASE-806; AFCRL-65-3; AD-612282)

Research was carried out on the growth of single crystals of plain and doped sapphire, ruby, spinel, yttrium oxide, magnesium titanate, yttrium iron garnet, beryl, cerium molybdate, lanthanum molybdate, sodium ferrite, and high melting fluorides. The methods of growth studied were the Verneuil and Czochralski techniques, and growth from a flux. The work resulted in the development of a new three-tube Verneuil burner, as well as the production of more than 70 single crystal boules by the Verneuil process. Preliminary work on a new powder feed mechanism for the Verneuil furnace is described. A long-range program for the Czochralski and flux growth of corundum and the initial results from this program are described with the equipment modifications necessary. Results from attempts to use the Czochralski method for the production of cerium molybdate, lanthanum molybdate, and yttrium iron garnet are included as well as a review of the technical needs for the laboratory production of single crystals of the metallic fluorides. Author

N65-20003# Army Electronics Labs., Fort Monmouth, N. J.
DIRECT PRODUCTION OF ELECTRICAL PULSES FROM GALVANIC CELLS I
Herbert F. Hunger, James E. Wynn, and Nunzio J. Sanfilippo Oct. 1964 27 p refs
(ECOM-2520; AD-611748)

An experimental method was found to study the oscillatory behavior of anodic half elements in combination with a simulated, electromotively active counter electrode. The half elements under investigation were methanol and formaldehyde at platinized platinum electrodes and room temperature in sulfuric acid electrolyte. Simultaneous current and voltage oscillations of various amplitudes and frequencies were observed. Various waveforms of the oscillations were found and classified in oscillation patterns. A reaction mechanism explaining the oscillatory behavior has been suggested. Based on the theory that at least two simultaneous reactions are necessary for a periodic reaction to occur, two possible reactions were identified. Experimental evidence in support of the suggested mechanism is presented. A correlation between electrode activity and time effects on the oscillatory behavior of the half elements was established. Influence of electrode pretreatment (hydrogen deposition) on the oscillations was also investigated. Author

N65-20011# Weizmann Inst. of Science, Rehovoth (Israel).
INTERPRETATION OF SPECTRA OF HCl AND DCl IN AN ARGON MATRIX Technical (Scientific) Note No. 12
H. Friedman and S. Kimel Dec. 1964 7 p refs
(Contract AF 61(052)-388)
(AFCRL-65-107; AD-612089)

A treatment in which the J-dependent part of the shifts is attributed to the effect of rotation-translation coupling is reported. In this model it was assumed that the intermolecular potential energy depends only on the positions of the centers of interaction of the atoms and of the trapped molecule. The center of interaction depends on the charge distribution and, in molecules, it does not, generally, coincide with the center of mass. In addition, it was assumed that the molecule moves

in a spherically symmetrical harmonic field due to surrounding atoms. This is the harmonic-oscillator-cell model. It was concluded that the center of interaction is very close to the center of mass and therefore to the chlorine nucleus. A further check was made on DCl. Theoretical calculations agree with the experimental values. E.E.B.

N65-20013# New York Univ., N. Y. Research Div.
INVESTIGATION OF THE PREPARATION OF HIGH PURITY METALS VIA THE DECOMPOSITION OF CYCLOPENTADIENYL AND ARENE PI-COMPLEX COMPOUNDS Final Report, Nov. 1, 1962–Oct. 31, 1964
Minoru Tsutsui and Charles J. Marsel 31 Oct. 1964 46 p refs
(Contract AF 19(628)-1685)
(AFCRL-64-934; AD-612074)

This report discusses research on the preparation of high purity metals via the decomposition of cyclopentadienyl and arene- complex compounds. The preparation, purification and characterization of a new europium compound, tricyclopentadienyl–europium, are reported. Experiments relating to the synthesis, purification and decomposition in vapor and liquid phase of chromium and nickel compounds are also described. Author

N65-20033# Douglas Aircraft Co., Inc., Newport Beach, Calif. Astropower Lab.
SOLUTION AND CONDUCTIVITY STUDIES IN FLUORINE-CONTAINING LIQUID OXIDIZERS Quarterly Progress Report, 15 Sep.–15 Dec. 1964
M. S. Toy, W. A. Cannon, and W. D. English [1964] 38 p refs
(Contract DA-31-124-ARO(D)-115; ARPA Order-470)
(Rept.-144-Q6; AD-455148)

This report summarizes the results of solution and conductivity studies on fluorine-containing oxidizers. The frequency effects in conductivity measurements of bromine trifluoride and of aqueous N/1000 potassium chloride were measured and the results are discussed. Conductivity versus temperature studies of bromine pentafluoride and conductivity versus photolysis of neat tetrafluorohydrazine and of its binary mixture with arsenic pentafluoride were described. The significant accomplishment was the isolation of two solid oxidizers, both of which are thermally stable and reacted violently with most organic substances. The second significant accomplishment is that one of the synthesized ionic solid oxidizers in bromine trifluoride solution reached an equivalent conductivity of a 10th normal aqueous potassium chloride. Author

N65-20039# Naval Research Lab., Washington, D. C. Chemistry Div.
THE STABILIZATION OF MONOETHANOLAMINE SOLUTIONS FOR SUBMARINE CARBON DIOXIDE SCRUBBERS
C. H. Blachly and H. Ravner 4 Dec. 1964 16 p refs
(NRL-6189; AD-609888)

Monoethanolamine (MEA) is at present stabilized with a chelating agent, the monosodium salt of N,N-diethanolglycine (VFS). In dynamic tests at 131° F the additive did not prevent oxidative degradation of the amine when copper was present in the concentrations usually found in scrubber solutions. Effective stabilization in the presence of copper was given by the tetrasodium salt of ethylenediaminetetraacetic acid (EDTA). At 208° F in the presence of several metal contaminants, a combination of VFS and EDTA was required for stabilization. Both VFS and EDTA were shown to be true antioxidants for MEA. Static tests to simulate stripper operation revealed the amine to be reasonably stable against thermal degradation at 280° and 300° F. A combination of VFS and EDTA did not prevent oxidation of the amine at these temperatures when small amounts of oxygen were present. It was recommended that contamination by copper be curtailed to increase the service life of CO_2 scrubber solutions and that a combination of VFS and EDTA be used as a stabilizing additive package. Author

N65-20050# IIT Research Inst., Chicago, Ill. Technology Center
RESEARCH ON A HOT-ATOM CATION-DEFIXATION METHOD FOR THE PRODUCTION OF ENRICHED Co-60 AND Ba-139
P. Y. Feng 4 Jan. 1965 62 p
(Contract AT(11-1)-578)
(IITRI-578P15-12) CFSTI: $3.00

A modified Szilard–Chalmers process for the production of enriched radioisotopes requiring neither changes in the oxidation states of the elements involved, nor in organic complexes with inherently low radiation resistances is described. The ability of certain aluminum silicates to fix cations inside their lattice structures, and the subsequent defixation of the activated nuclei by means of nuclear recoil is the basis for the method. Experiments involving low integrated flux irradiations showed that the isotopes produced have generally been enriched as the result of the process. The highest specific activity achieved was approximately 2.3 curies/gram for a sample irradiated for 8.25 hours at approximately 6×10^{13} neutrons/cm^2sec, corresponding to an enrichment factor of about 50. The highest experimental efficiency for Co^{60} extraction was 9% as compared to the theoretical limit of 33%. E.E.B.

N65-20054# Union Carbide Research Inst., Tarrytown, N. Y. Mining and Metals Div.
METHODS OF ANALYSIS OF METAL REFRACTORIES-BORIDES, CARBIDES AND NITRIDES OF HAFNIUM NIOBIUM, TANTALUM, TITANIUM AND ZIRCONIUM
R. E. Dutton, G. J. Mc Kinley, D. Mc Lean, and H. F. Wendt Feb. 1965 25 p refs
(Contract DA-30-069-ORD-2787; ARPA Order 34-63)
(C-29; AD-459048)

The pyrohydrolysis technique for determination of boron in refractory borides consists of the passing of steam over a heated boride sample, collecting, and measuring the evolved boric acid. The boric acid is then converted to relatively strong acid by the addition of mannitol, and titrated with standard sodium hydroxide solution. Free carbon in refractory carbides is determined by dissolving with nitric and hydrofluoric acids. Boric acid is added, and the solution filtered through a Leco filtering crucible. After drying at 110° C for 1 hour, crucible and contents are ignited in a Leco furnace and the carbon dioxide is absorbed and weighed. Zirconium and tantalum in mixed carbides are determined by ignition at 1100° C, and the oxides fused in sodium bisulfate. The resulting melt is dissolved in oxalic acid solution, and the oxalato complexes are selectively eluted in an anion exchange column. The metals are then precipitated with cupferron and determined as the oxides. E.E.B.

N65-20076# Atomic Energy of Canada, Ltd., Pinawa (Manitoba). Whiteshell Nuclear Research Establishment
THE RADIATION-DECOMPOSITION CHARACTERISTICS AND PHYSICAL PROPERTIES OF THREE LOW-MELTING ORGANIC COOLANTS FOR REACTORS

M. Tomlinson, M. G. Bailey, and R. R. Tymko Apr. 1964 43 p refs
(AECL-1915) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.00

The radiation-decomposition, high-boiler production, gas evolution and other characteristics of a near-eutectic mixture of diphenyl with ortho- and meta-terphenyl, and of two partly hydrogenated terphenyl mixtures, all three liquid at or below 40° C, were surveyed and compared with the behavior of a reference terphenyl mixture. The method was by sealed capsule irradiations at 300° to 400° C and up to 14 Wh/g absorbed dose in a fast neutron enhanced facility in the NRX reactor. Pyrolysis rates at 375° to 475° C were also examined. The vapor pressures, densities, viscosities, melting characteristics, and rates of deposition on heat-transfer surfaces were assessed, for larger quantities of materials irradiated in a loop facility in NRX, and for the starting materials. The hydrogenated mixtures were slightly less stable than the unhydrogenated mixtures under irradiation and produced about ten times as much gas, but they gave a lower proportion of high-boiling products. Thermal decomposition of the hydrogenated mixtures was about ten times faster than for the others. In general, the physical properties of the mixtures were similar. Author

N65-20093# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
EXTRACTION OF SOME LANTHANIDES WITH SEVERAL ORTHOPHOSPHORIC ACID ESTERS
F. Krasovec and C. Klofutar Nov. 1964 17 p refs Submitted for Publication
(NIJS-R-440)

Equilibrium constants K_3 and K_5 were calculated. It was observed that a linear relationship between log K_3 and log $K_d.K_a^{-1}$ exists. With the aid of this relationship an empirical equation was derived enabling prediction of the efficiency for the extraction of trivalent lanthanides of any aromatic ester of orthophosphoric acid, if its acid dissociation (K_a), distribution (K_d) and dimerization (K_2) constants are known. The results further show that a high extraction efficiency will be exhibited by phosphoric acid esters having a high acid dissociation and distribution constant and a low dimerization constant. Author

N65-20097# Joint Publications Research Service, Washington, D. C.
ON THE NEW PROCEDURES FOR PRODUCING RADIOACTIVE COLLOIDAL GOLD ^{198}AU IN THE "BORIS KIDRIC" INSTITUTE AT VINCA
Rade Draskovic, Jelisaveta Cvoric, Sreten Vukicevic, and Ratko Ilic 24 Mar. 1965 16 p refs Transl. into ENGLISH from Tehnika (Belgrade), v. 20, no. 2, 1965 p 228–233
(JPRS-29258; TT-65-30572) CFSTI: $1.00

Modifications of a method for production of radioactive colloidal gold ($^{198}Au^{1+}$) are reported. Two advantages are achieved, important in medical applications. The first of these is the homogeneous dispersal of the radioactive colloidal particles (200 ±50 Å). The second advantage is the presence of only 0.5% to 0.7% of the radioactive impurity, $^{198}Au^{3+}$. E.P.V.

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N65-18630# New York Univ., N. Y.
AN INTRODUCTION TO ERROR CONTROL TECHNIQUES
Jack Keil Wolf Griffiss AFB, N. Y., RADC, Jan. 1965 18 p refs Presented at the Meeting of the Mil. Commun. System Tech. Standards Comm., Washington, D. C., 14 Oct. 1964
(Contract AF 30(602)-3450)
(RADC-TR-64-558; AD-610866)

The objective is to formulate a common structure in which may be imbedded various techniques for the control of errors in communication systems. The relationship between digital error correction and error-detection coding techniques and modulation systems is examined. A brief exposition is presented on the more promising techniques that have been proposed for digital coding. Author

N65-18637# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
USE OF EXPERIMENTAL DATA IN CALCULATING THE RELIABILITY OF RADIOELECTRONIC EQUIPMENT, BASED ON THE POISSON DISTRIBUTION
G. B. Linkovskiy 18 Mar. 1963 6 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zaved., Priborostr. (Leningrad), no. 5, 1961 p 43–46
(FTD-TT-63-38/1+2; AD-402426)

An American paper on the theory of reliability testing based on the Poisson distribution is considered. The probability that exactly k failures will take place during the time t is formulated according to Poisson's law. Individual observations of the time between failures are introduced. The probability function showing the number of failures for the fixed time t is analyzed and found to be an asymptotic normal. The mathematical expectation and variance of the probability function are given in formulas. D.E.W.

N65-18638# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASURING THE PARAMETERS OF ANTENNA-FEEDER DEVICES (SELECTED PARTS)
A. Z. Fradin and Ye. V. Ryzhkov 26 Mar. 1963 15 p Transl. into ENGLISH from the book "Izmereniye Parametrov Antenno-Fidernykh Ustroystv" Moscow, 1962 p 266–272, 314–316
(FTD-TT-63-42/1+2; AD-401599)

Airborne equipment for plotting diagrams of directivity, consisting of transmission devices, auxiliary antenna, and instruments for tracking the aircraft, is discussed. The plotting is best done from a helicopter, since it is less difficult to correlate instrument readings with the exact location of the helicopter. More complicated radar observation is required for fixed-wing aircraft. E.E.B.

N65-18690# Hughes Aircraft Co., Culver City, Calif.
PROPAGATION OF ELECTROMAGNETIC WAVES THROUGH INHOMOGENEOUS SLABS Scientific Report No. 8
A. T. Villeneuve Oct. 1964 45 p refs
(Contract AF 19(604)-8386)
(P64-116; AFCRL-65-16; AD-610838)

An approximation technique is considered for computing transmission and reflection coefficients for plane waves propagating through stratified slabs. The approximation uses a mapping of the given problem onto a similar, but exactly solvable problem. The approximate solution is then expressed in terms of the solution of the exactly solvable problem. As an illustration of the technique, the reflection and transmission coefficients of a transition layer are computed. Agreement between the exact and approximate values of the coefficients is good. Author

N65-18697# Transco Products, Inc., Venice, Calif.
SMALL, LIGHTWEIGHT ALTITUDE TRANSMISSION EQUIPMENT (SLATE) Final Report
Jul. 1964 53 p
(Contract FAA-ARDS-476)
(RD-64-110; AD-610779)

This report describes the development of experimental SLATE transponders, airborne equipment designed primarily for use in the Air Traffic Control Radar Beacon (ATCRBS) environment. Four types of transponders were developed, each containing progressive increases in sophistication so that the effectiveness of each type in air traffic control could be separately evaluated. The altitude encoder which was developed for use with the transponders has two versions—an altitude digitizer, and an altimeter–digitizer. Several basic designs of transponder circuitry were investigated in an attempt to reduce size, weight, power consumption and cost. This included a magnetic recording encoder–decoder, TRF receiver, digital clock–matrix encoder, and various transmitter, i.f. amplifier, and SLS circuit configurations. The final design resulted in a family of SLATE transponders, each weighing under 4 pounds, with dimensions approximately 3 1/4 × 3 1/4 × 12 inches, all panel mounted units with power consumption under 25 watts. Author

N65-18698# Mitre Corp., Bedford, Mass.
COMPARATIVE PERFORMANCE EVALUATION OF DIGITAL DATA MODEMS FOR HF RADIO
R. E. Greim, W. R. Menges, and F. N. Nelson, Jr. Jan. 1965 94 p refs
(Contract AF 19(628)-2390)
(TM-04101; ESD-TDR-64-631; AD-610675)

Field testing of evaluation models of new phase-shift keyed (PSK) modems was conducted over a leased 6900-nautical mile HF radio circuit from Pretoria, South Africa, to Riverhead, New York. The superior bandwidth economy of PSK over frequency-shift keyed (FSK) modulation was demonstrated. This work was part of the ESD program to improve missile test range HF digital data transmission. Author

N65-18748# Joint Publications Research Service, Washington, D. C.
TESTING DISCRETE COMMUNICATIONS SYSTEMS AND AUTOMATION OF LONG DISTANCE FACILITIES
3 Mar. 1965 19 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 12 Dec. 1964 p 56–63, 80
(JPRS-28969; TT-65-30426) CFSTI: $1.00

CONTENTS:

1. CODE SEQUENCES FOR TESTING DISCRETE COMMUNICATIONS SYSTEMS V. S. Bleykhman and K. A. Brusilovskiy p 1–13 refs (See N65-18749 09-07)
2. CONFERENCE ON THE AUTOMATION OF LONG DISTANCE COMMUNICATION FACILITIES I. P. Petrushin p 14–16

N65-18749 Joint Publications Research Service, Washington, D. C.
CODE SEQUENCES FOR TESTING DISCRETE COMMUNICATIONS SYSTEMS
V. S. Bleykhman and K. A. Brusilovskiy *In its* Testing Discrete Commun. Systems and Automation of Long Distance Facilities 3 Mar. 1965 p 1–13 refs (See N65-18748 09-07) CFSTI: $1.00

It is shown that for the conformity of statistical structures of the test signals and actual messages in the data transmission systems the signals mentioned must be constructed on the basis of regular code sequences or code rings. Methods of designing the transmitters of such signals are examined. Author

N65-18753 Joint Publications Research Service, Washington, D. C.
OPTIMAL DETECTION OF A MARKOV PROCESS IN NOISE
R. L. Stratonovich and Yu. G. Sosulin *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 12–30 refs (See N65-18751 09-34) CFSTI: $6.00

A method is discussed for the solution of problems of optimal detection of Markov processes in noise. The structure of a circuit is determined which realizes optimal detection of a Markov process in uncorrelated noise. The general relationships are made specific in a particular example. Cases are considered of discrete and continuous observation times. A posteriori probabilities of errors of the first and second type are introduced, with which it is possible to find the usual probabilities of errors of the first and second type. Where the observation time is significantly greater than the time of correlation of the detected process, expressions are obtained for a priori probabilities of errors of the first and second type. Author

N65-18794# Hazeltine Research Corp., Little Neck, N. Y. Electronics Div.
DOUBLE-SIDEBAND DOPPLER VOR EQUIPMENT Final Report
W. S. Sturgeon 16 Oct. 1964 47 p
(Contract FAA/BRD-376)
(Rept.-10143)

This report describes the design and fabrication of a double-sideband Doppler VOR transmitter and distributor for modifying present Doppler VOR ground station equipment to provide the radiation of a double-sideband variable-phase signal which approximates the radio signal of the conventional VOR ground station but using the Doppler technique. The transmitting equipment consists of two sideband generators individually phase-locked to the carrier, individual automatic level control circuits, power supplies, and associated control circuits. A distributor was designed for feeding each sideband to opposite sides of a Doppler VOR antenna system and commutating the outputs to all the antennas at a 30-cps rate. A method was devised to couple both sidebands into the rotating portion of the distributor without excessive power loss or phase shift. Rotor and stator plate configurations were designed to provide the desired power transfer function from the distributor rotor to the antennas. Author

N65-18823* National Aeronautics and Space Administration, Washington, D. C.
TELETRANSMITTER
Katsuhiko Ohi, Masoich Hakui, and Mitsuo Kazitani *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 155–161 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Improved transmitters are described for higher altitude Kappa and Lambda rockets in the Japanese space program. Transistors were adopted to reduce the weight of the Kappa transmitting payload; a simpler airtight enclosure, and an accurate, durable remote control switch were designed. For the Lambda series, a crystal control transmitter was developed to improve the S/N ratio of the radio receiver by narrowing the signal band. J.M.D.

N65-18824* National Aeronautics and Space Administration, Washington, D. C.
HIGH-RESPONSE RADIO RECEIVER (PART 2)
Kenich Takahashi *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 162–167 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Noise reduction in the amplifier tube and phase detecting system of an FM high-response radio receiver is reported. Low noise from the ceramic vacuum tube amplifier was achieved by building a coaxial input and an output resonant circuit. In the phase detector section the lower limit of improvement in signal-to-noise ratio was determined mathematically; the rate of decrease in improvement was calculated as a function of the ratio (maximum frequency discrepancy)/(maximum modulation frequency). J.M.D.

N65-18825* National Aeronautics and Space Administration, Washington, D. C.
DEMODULATOR-RECORDER SYSTEM
Katsuhiko Ohi and Shisato Torii *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 168–172 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

A 10-channel demodulator and tape recorder in a radio receiver system is described; the receiver system was used in the Kappa-3 rocket tests in the Japanese space program. The demodulator employs a pulse-delay frequency discriminator which has improved the tape recorder response. The tape recorder was added to record the mixed signal which enters the demodulator, for preventing loss of data, and for data storage. It is stated that stability and linearity of the demodulator were improved, and that the tape recorder functions well. J.M.D.

N65-18826* National Aeronautics and Space Administration, Washington, D. C.
TELEMETRY ANTENNAS
Fujio Yamashita and Yoseki Inane *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1945 p 173–178 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Two recent rocket antennas used for telemetry are discussed. The tail stretched-out hoop antenna has the advantages of wide frequency band characteristics, ease in controlling the radiation pattern, and low cost. On the other hand, a body hook antenna has an ideal radiation pattern and strong mechanical strength, a short power input line, and is not affected by exhaust flames. Therefore, the former is useful for a small space rocket such as the K-6 type, and the latter, with some improvements, can be used in a much larger space rocket.
Author

N65-18827* National Aeronautics and Space Administration, Washington, D. C.
THE TELEMETRY EXPERIMENT DURING KAPPA 8 TYPE NO. 8 THROUGH NO. 11 SPACE ROCKET FLIGHTS
Noboru Takagi, Tamiya Nomura, Sachetsugu Yokayama, Sigehito Yokoyama, Kosoburo Inoue et al *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 179–185 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Modifications of the teletransmitter during tests of Kappa rockets 8 through 11 are noted. The teletransmitter was transistorized for compactness, as more observational instruments were added to the rocket payload. The number of channels was increased from 8 to 10. Test flights revealed that the teletransmitter signal was weak, and that the frequency changed rapidly over a large band; these problems are discussed. J.M.D.

N65-18828* National Aeronautics and Space Administration, Washington, D. C.
4 m ϕ RADAR SYSTEM
Tamiya Nomura, Junsho Kashimoto, and Masaru Watabe *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 186–204 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Design details are given for a parabolic antenna radar system for tracking rockets, and for recording their flight trajectories. The system can track either a large rocket carrying a radar transponder or a small rocket without transponder, and in long or short flight. A pen-writing device draws the rocket trajectory on graph paper; graphs are shown for flight of a Kappa-9L rocket in the Japanese space program. J.M.D.

N65-18829* National Aeronautics and Space Administration, Washington, D. C.
RECEIVING LEVEL CHANGE CAUSED BY THE ANTENNA MOUNTED IN THE ROCKET BODY
Noboru Takagi, Kaneyuki Kinokawa, Motomi Nagatani, Mitsum Ichigawa, and Minoru Sekikuchi *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 205–214 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Various rocket-mounted radar antennas are discussed with respect to their effects on receiving level at ground stations. The antennas were (1) the pole type fixed to the rocket body, and (2) the notch type at the tail; the rockets were in the Kappa series used in the Japanese space program. Directivity characteristics are presented for the antennas, and flight data show the irregularity of receiving level across the rocket trajectory. J.M.D.

N65-18839* National Aeronautics and Space Administration, Washington, D. C.
OPTICAL TRACKING OF KAPPA-8 TYPE ROCKETS (-7, -8, -9 AND -11 TYPE) Thirty-Ninth Report on the Research of the Optical Tracking of a High-Speed Body
Hisaaki Uemura, Katsuya Tanaka, Kazuo Kanezawa, and Yoshiaki Kurokawa *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 267–273 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The K-8 space rocket flight was filmed with a 16-mm prism high-speed camera. The launch and flight of the rocket were filmed. The time length from the rocket ignition flash to the moving of a rocket depends upon the total weight and the launch angle of the rocket. The K-8-8 had the longest time, 0.02 seconds. Initial motion was similar to that of other rockets; this was estimated from the flame and later motion of the rocket. R.W.H.

N65-18840# National Aeronautics and Space Administration, Washington, D. C.
OPTICAL TRACKING OF THE K-9L-2, -8L-1 AND 9M-1 TYPE SPACE ROCKETS Thirty-Ninth Report on the Research on the Optical Tracking of a High-Speed Moving Body
Hisaaki Uemura, Kanzi Ito, Katsuya Tanaka, Yoshitaka Yamamoto, and Kazuo Kanezawa *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 274–279 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The film of the rocket from ignition until it went 5 m above the launcher was taken from a high-speed camera observation point. The tracking pictures were taken by a magnifying tracking system from the central observation point. The K-9L-2 space rocket started to move 15 msec after the flash ignition and left the launcher 460 msec after ignition. Due to bad weather, the trajectory of the rocket could not be tracked. It was found that the rockets were stable when leaving the launcher. R.W.H.

N65-18841* National Aeronautics and Space Administration, Washington, D. C.
OPTICAL TRACKING OF SMALL MODEL ROCKETS High-Speed Optical Tracking Research Report No. 40
Hisaaki Uemura, Ketsuya Tanaka, Kazuo Kanezawa, and Tokio Kitahara *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 280–287 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Small rockets have much higher velocities than large space rockets, therefore, natural background was used for the filming. It was concluded that two observation points were required to obtain the trajectory of a rocket. Bad weather conditions prevented the obtaining of useful data. R.W.H.

N65-18842* National Aeronautics and Space Administration, Washington, D. C.
SUPPORTING TOWER FOR 18-mϕ TRACKING TELETRANSMITTER ANTENNA
Takakazu Maruyasu and Hideo Nakamura *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 288–293 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The supporting tower designed for the 18-mϕ parabolic antenna is briefly described. The tower is a reinforced concrete cylindrical structure, the first of its type to be designed in Japan. Due to such unproved problems as load conditions and stress distribution, a wide margin of safety in the design was adopted. R.W.H.

N65-18848* National Aeronautics and Space Administration, Washington, D. C.
OBSERVATION OF THE PROPAGATION MODE OF LOW FREQUENCY RADIO WAVE AND NOISE IN THE IONOSPHERE BY K-8-11 TYPE SPACE ROCKET
Kenichi Maeda, Iwane Kimura, and Tatsuo Takagura *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 334–343 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The nose cone of the rocket was opened 79.6 seconds after the launching at altitude 95 km, and each channel started to receive through the exposed loop antenna and stretched out dipole antenna. In the descending period of the rocket, the teletransmitter had burnt away at about 40 km altitude, 421 sec after the launching, and the signal faded out. During the flight, all channels received intense pulse-type noises. The levels of the pulse-type noises were not necessarily random but changed within 50 sec period and sometimes the levels fell below the noise level of the receiver for 3 to 5 sec. Possible causes of the noises include intermittent breakdown of ionized particles and meteor radiated waves. R.W.H.

N65-18872# Raytheon Co., Norwood, Mass.
CONDUCTIVITY MEASUREMENTS IN DISSIPATIVE MEDIA WITH ELECTRICALLY SHORT PROBES Scientific Report No. 6
Carson K. H. Tsao Aug. 1964 28 p refs
(Contract AF 19(628)-2362)
(AFCRL-64-848; AD-609684)

In a dissipative medium, the input conductance of either a bare or an insulated short-circuited dipole is simply related to the conductivity of the medium, provided the electrical length of the dipole is short. Model measurements were made in salt solution of water to demonstrate the feasibility of deducing conductivity of the solution by using both types of antennas as probes. The technique was utilized to evaluate the electrical conductivity of rock media in deep drill holes. Since rock media are rarely uniform in their electrical characteristics, the deduced conductivity will be a gross average conductivity of that volume of the rock approximately within the antenna region of the probe. Author

N65-18895# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering
STUDIES OF ELECTROMAGNETIC COMPATIBILITY OF EQUIPMENT AND SYSTEMS Progress Report No. 13, 1 Nov. 1963–31 Jan. 1964
R. M. Showers, S. C. Moorthy, M. Massaro, A. Weinrach, H. L. Logan et al 9 Feb. 1964 30 p ref
(Contract NObsr-85170)
(Rept.-64-18; AD-454589)

Means by which electromagnetic sources produce interference in an electromagnetic system were studied by insertion of quantitative data into a simple system model subjected to the normal effects of a probable electromagnetic environment. Quantitative results of the analysis are tentative and do not necessarily indicate actual situations. It was concluded that, with the assumed noise sources, the existing system will not meet the performance criterion of no audible interference. Source impedance characteristics, cable coupling, and electrode noise caused by reactions between salt (sea water) and metal electrodes are also reported. Experiments conducted on the theory of correlation between electric and magnetic sensors, previously reported, were modified. Experimental results have shown that the compensating network does provide correlation between electric and magnetic sensors. E.E.B.

N65-18901# Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE ANGULAR RESOLUTION OF MULTIPLE TARGETS
J. R. Sklar and F. C. Schweppe 14 Jan. 1964 24 p refs *Its* Group Rept.-1964-2
(AD-430185)

The angular accuracy obtainable from an aperture of fixed size is considered, with emphasis on the multiple target case. By means of the Cramer–Rao inequality, a lower bound to the measurement variance is computed. In addition, the degradation due to uncertainties in the number of targets present is considered. Loss of accuracy is small until the targets approach to within one beamwidth, at which point the degradation becomes severe. Author

N65-18904# Goodyear Aerospace Corp., Akron, Ohio.
ADVANCED ANTENNA DESIGN TEST PROGRAM First Semiannual Report, 15 Mar.–30 Sep. 1964
D. D. Collins and J. C. Bell, Jr. 15 Oct. 1964 155 p
(Contract DA-28-043-AMC-00036(E))
(GER-11754; AD-452219)

The objective was to provide an antenna structure design that would prevent initial wrinkling of the fabric while operating in 50-mph wind and to maintain the required contour accuracy and pointing accuracy under this wind loading. Detail

analysis of the structure as initially designed, however, showed that the internal pressure required to prevent wrinkling in 50-mph wind gave a factor of safety in the fabric below the desired 3.0. For this reason, the rigid center hub size is being increased slightly to permit a lower operating pressure for the 50-mph wind condition. This change in design reduces the load in the fabric enough to give the desired safety factor of 3.0. The 10-foot inflatable antenna reflector design utilizes gored fiberglass fabric surface skins with internal radially spaced fiberglass fabric shear webs to form a concave paraboloidal dish when pressurized. The fabric structure is attached to a rigid metallic center hub that completes the reflector structure and supports the feed system. Flexible foam is molded on the front face of the reflector structure to an accurate paraboloidal contour and is then painted with a flexible rf reflective coating. The feed is a center fed waveguide to dipole radiator excited cavity. Author

N65-18905# Varian Associates, Beverly, Mass. Bomac Div.
NOISE SOURCE FOR MILLIMETER WAVELENGTH Fourth Quarterly Progress Report, 1 Apr.–1 Jul. 1964
Arnold M. Eklund 30 Aug. 1962 17 p
(Contract DA-36-039-AMC-03229(E))
(NR-4; AD-453097)

After investigation of the balanced mixer as the front end of the noise detector system, the assembly was determined to be nonoperational to date, and results obtained from a single-ended mixer have been more successful. A maximum insertion loss of 0.4 dB was measured for the hot load assembly at 600° C. Using a single-ended mixer, noise from a K_A-band noise source was detected at both 70 and 94 Gc. Also, noise from the hot load assembly at 1000° C has been detected at 94 Gc. Author

N65-18943*# Hallicrafters Co., Chicago, Ill.
STUDY OF COMMUNICATIONS SYSTEMS, AND DETECTION AND TRACKING SYSTEMS. DESIGN AND FABRICATION OF DYNAMIC CROSSED-FIELD ELECTRON-MULTIPLYING LIGHT DEMODULATOR Periodic Progress Report No. 2, 20 Jun.–20 Sep. 1964
M. Ross, R. Hankin, E. Dallafior, R. Swendsen, and T. Curran [1964] 41 p refs
(Contract NAS5-3777)
(NASA-CR-57187) CFSTI: HC $2.00/MF $0.50

This report presents results of an optical communications and tracking systems program divided as follows: Task I—analyze laser communications, detection, and tracking systems; Task II—disseminate the results of Task I through a lecture series; Task III—develop a microwave bandwidth dynamic crossed-field electron multiplier demodulator. Task I results include an analysis of laser receiver statistics and noise, a summary of noise sources with a discussion of origin and effect, and an analysis of information theory aspects wherein quantum effects at optical frequencies are considered. Equations, charts, and graphs are provided. Five lectures were given under Task II on radiation laws and statistics, noise and fluctuations, detection statistics, and information theory aspects. Task III results include construction of cylindrical geometry dynamic crossed-field electron multiplier light demodulators and preliminary measurements of frequency response. Author

N65-18945*# Harvard Univ., Cambridge, Mass. Gordon McKay Lab.
THE RESISTIVELY-LOADED V-ANTENNA. CURRENT DISTRIBUTION, IMPEDANCE, AND TERMINAL-ZONE CORRECTION RADIATION FIELD Scientific Report No. 3
Bob M. Duff Oct. 1964 27 p refs
(Grant NsG-579)
(NASA-CR-57182) CFSTI: HC $2.00/MF $0.50

The apparatus used to measure the distribution of current along a V-antenna resistively loaded about a quarter wavelength from the end is described. The measured distributions of current for several angles Ψ between the arms of the V are shown graphically for antennas with arm lengths $h = \lambda$ and $h = 2\lambda$. In each case a resonant upper section about $\lambda/4$ in length is connected to the main antenna by means of a resistor R. It is shown that with R near 120 ($ln\ 2h/a - 1$) ohms the current on the main section is essentially a traveling wave with nearly constant amplitude and uniformly increasing phase. This distribution is affected only slightly by changes in the angle Ψ between the arms of the V. It is changed if R is varied significantly from the above-mentioned value. Author

N65-18949*# RAND Corp., Santa Monica, Calif.
A PROPOSED METHOD FOR ON-BOARD MONITORING OF DISCRETE SIGNALS
L. D. Amdahl and L. T. Mast Feb. 1965 23 p refs
(Contract NASr-21(08))
(NASA-CR-57171; RM-4455-NASA) CFSTI: HC $1.00/MF $0.50

Prelaunch checkout of a space vehicle involves monitoring of hundreds of discrete (on–off) signals. Present design requires that a great many of these discrete signals be brought out from the launch vehicle in the umbilicals. This report describes an onboard method of monitoring discrete signals such that only change information need be reported to ground equipment. This change information can be multiplexed, thus eliminating a large number of umbilical signal wires otherwise required, and effecting a modest weight saving. Further weight saving can be accomplished by using integrated circuits in the onboard monitoring units. Finally, more postlaunch data can be made available to the ground system by telemetering the discrete signal change data. Author

N65-18961# Air Force Cambridge Research Labs., Bedford, Mass. Office of Aerospace Research
ERROR PROBABILITIES FOR CERTAIN SPREAD CHANNELS Physical and Mathematical Sciences Research Papers No. 72
John N. Pierce Dec. 1964 65 p refs
(AFCRL-64-978; AD-609919)

On an overspread channel, the total average energy in a received signal is divided among a large number of independently fading components, and the distribution of energy among these components can be only partially controlled by the signal design. It is shown, by numerical results for a specific class of modulating waveforms and scattering functions, that this unavoidable energy division can be almost as efficient as the controlled division of energy achieved by frequency diversity on an underspread channel. It is also shown that M-ary transmission alphabets are effective in combating extremely severe channel overspreading. Asymptotic results, derived for long rectangular modulating pulses, permit determination of a lower bound on channel capacity that depends only on certain marginal properties of the scattering function. Author

N65-19018# Goodyear Aerospace Corp., Akron, Ohio.
MEASUREMENTS AND MODELS FOR RELATING THE PHYSICAL CHARACTERISTICS OF IMAGES TO TARGET DETECTION Technical Report, Jul. 1962–Sep. 1963

Donald G. Corbett and N. D. Diamantides Wright-Patterson AFB, Ohio. AMRL. Dec. 1964 107 p refs
(Contract AF 33(657)-9476)
(AMRL-TR-64-117; AD-610254)

Three metrics of predicting the time required to identify targets in high-resolution radar pictures were developed. One metric, based on four automatically measured variables related to transmissivity of positive transparencies, was tested. Through multiple-regression analysis, a correlation of 0.69 between observed and predicted identification times was obtained. When these relationships were applied to a new set of radar pictures and new test subjects, the correlation coefficient was too low to be significantly different from zero with the number of pictures used. A principal reason for the low correlation was the unexpected correlation between the four transmissivity variables. The metric also had an insignificant correlation coefficient when applied to optical and infrared photographs (0.07 and 0.04, respectively). It is hypothesized that, if additional variables are utilized, the metric examined in this study may be useful as a base to develop a more effective prediction equation. Author

N65-19030# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVICE FOR PRIMARY PROCESSING OF A SIGNAL
R. L. Drabkin 2 Dec. 1964 7 p refs Transl. into ENGLISH of the RUSSIAN Patent No. 153943 (Appl. No. 760481/26-9), 22 Jan. 1962 p 1–4
(FTD-TT-64-423/1+2; AD-611044)

A block diagram is given for a proposed device consisting of a pulse shaper, four time-channel switches, a reference generator, a commutator, and two reversible pulse converters. The received signal is split into four time channels, compared with the reference signal, and passed on as digital information to a computer, for secondary processing. This frees the digital computer from the necessity of filtering out interference. E.P.V.

N65-19062# Philco Corp., Blue Bell, Pa.
SPACE-TIME DETECTION AND ESTIMATION
Harry Urkowitz [1964]. 38 p refs Presented at the Graduate Seminar, Princeton Univ., Dept. of Elec. Eng., N. J. 13 Feb. 1964
(RM-43)

The theory of the processing of space-time functions is presented, from the viewpoints of filtering to maximize signal-to-noise ratio, and of decision theory using a space-time likelihood ratio. In space-time processing, appropriate spectral functions are column vectors of signal spectra and spectral density matrices of the discrete set of time functions. In maximizing signal-to-noise ratio, the optimum set of filtering operations is given by a transfer function matrix equal to the product of a matrix inverse to the noise spectral density matrix and the conjugate of the signal spectrum matrix (a column vector). This is a generalization of a simpler result for one dimensional signals and noise. A generalization of the one-dimensional Karhunen–Loeve expansion applied to the noise vector random process permits obtaining a series representation with uncorrelated coefficients. The effects of aperture weighting and of both internal and external noise are considered in the general formulation. Author

N65-19087# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
EFFECT OF TURBULENCE INTERMITTENCY ON THE SCATTERING OF ELECTROMAGNETIC WAVES BY UNDERDENSE PLASMAS
K. T. Yen Nov. 1964 48 p refs
(Contract AF 04(694)-474)
(R64SD72; AD-611220)

In hypersonic turbulent wakes, mixing between the turbulent inner wake and the outer inviscid wake gives rise to the intermittency phenomenon. It is shown that electron-density fluctuations of a turbulent nature, in addition to those caused by turbulence, are produced by the intermittency phenomenon; these fluctuations depend on the mean electron-density distribution and Townsend's intermittency δ function. Application of this consideration to turbulent scattering by underdense plasma was made. Two contributions to the scattering cross section are obtained: The first arises from the intermittency phenomenon and vanishes if the intermittency is omitted; and the second is due to fluctuations caused by turbulence; this second contribution also contains the intermittency effect, and reduces to that given by the conventional turbulent scattering theory when the intermittency is not considered. Numerical results for the scattering cross section were obtained; based on these results, some characteristics of the scattering cross section are found to be significantly modified by the intermittency. Author

N65-19125# New York Univ., N. Y. Lab. for Electroscience Research
A NOTE ON SELECTION OF A CHANNEL MODEL First Scientific Report
John J. Metzner Dec. 1964 23 p *Its* Tech. Rept.-400-103
(Contract AF 19(628)-4321)
(AFCRL-65-19; AD-611309)

The finite-state channel model assumed in Shannon's noisy channel theorem yields the conclusion that error probability can be reduced exponentially with code length at any information rate less than channel capacity. Evidence from statistics of real channels suggests, however, that this exponential behavior is not achievable for any code duration which might conceivably be used in practice. This report exhibits an infinite-state model which leads to a somewhat different conclusion about what can be accomplished with coding than would be reached with a finite-state model; i.e., error probability can be reduced only as a small power of code length. Author

N65-19140# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN REMARKS ON SPECTRAL ANALYSIS OF NOISES
V. M. Zhuravlev 19 Feb. 1965 11 p refs Transl. into ENGLISH from Tekhn. Kina i Televideniye (Moscow), No. 9, 1963 p 25–29
(FTD-TT-64-713/1+2; AD-611746)

In this report is substantiated the possibility of employing heterodyne analyzers for spectral analysis of noise, and practical recommendations are given on the use for this purpose of analyzers, intended for studying periodic oscillations. Author

N65-19142# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF A METHOD OF PHASE MEASUREMENTS IN THE CASE OF NONCOHERENT SIGNALS
V. I. Medvedev 13 Nov. 1964 14 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 6, 1963 p 77–84
(FTD-TT-64-1173/1+2+4; AD-609149)

A method for measuring the change in phase difference between frequency-stable noncoherent signals with a significant frequency difference is considered and demonstrated. Experimental results verify the possibility of making phase measurements between noncoherent signals by this method. Author

N65-19158# Army Electronics Labs., Fort Monmouth, N. J. Meteorological Div.
A METEOROLOGICAL ROCKET BEACON TRACKING SYSTEM
Arthur A. Coppola Oct. 1964 55 p refs
(ECOM-2477; AD-611442)

A system designed to track rocketborne beacons to an altitude of 500 000 feet, without the requirement of radar support, is described. The system, designed to obtain density data during rocket ascent, consists of modifications and additions incorporated into the basic Rawin Set AN/GMD-1B in order to provide a relatively low-cost tracking system. Analysis of flight data obtained indicates that the design goals were attained. Rapid variations in pulse-rate telemetry can be reproduced and reduced through a comparison technique. Rocket-altitude data, when compared with data obtained with Radar Set AN/FPS-16, show an agreement to within 0.23%. The basic system accuracy in determining velocity proved to be as predicted, 1% or better. However, there were instances where deviations of velocity data, when compared with radar-determined velocities, were in excess of 1%. These were traceable to system noise preventing accurate readout. Author

N65-19159# Army Electronics Labs., Fort Monmouth, N. J. Electron Tubes Div.
SIGNAL AND NOISE PROPAGATION ON ACCELERATED BEAMS OF FINITE DIMENSIONS
Bruno Zotter Aug. 1964 52 p refs
(TR-2494; AD-608298)

The signal and noise propagation on a finite, accelerated electron beam in a diode space is calculated by a linearized field analysis. Approximate solutions are derived which show that the diode space behaves in general like a nonconservative transformation except when the transit angle is a multiple of 2π. The transformation of the noise parameters S and π is computed, and the results can be applied to the design of low-noise electron guns for traveling-wave tubes. Author

N65-19173# Clarkson Coll. of Technology, Potsdam, N. Y.
DIRECT MICROWAVE RADIATION FROM 100 KEV ELECTRON BUNCHES IN A CIRCULAR ORBIT Final Report, Apr. 1963–Sep. 1964
R. W. Redlich, J. F. Adams, L. G. Space, and W. Menges Griffiss AFB, N.Y., RADC, Jan. 1965 140 p refs
(Contract AF 30(602)-3049)
(RADC-TDR-64-458; AD-611161)

This task investigated the generation of microwave energy by direct radiation from electron bunches orbiting in a strong magnetic field. Electrons were injected into a magnetic field whose strength was 2000 gauss. Microwave energy was detected at the fundamental bunching frequency of 4000 Mc/sec. This energy was measured to be 0.2 microwatts. There was no detectable harmonic microwave energy. Experimental results were in general agreement with the theory, except that the radiation output was much lower than theoretical predictions. This was thought due to inadequate bunching. This program demonstrated that it is feasible to obtain direct microwave radiation by this method. Author

N65-19176# HRB-Singer, Inc., State College, Pa.
AN INVESTIGATION INTO EXISTING CALIBRATION METHODS OF FIELD INTENSITY METERS Final Report
Robert Marcus Griffiss AFB, N.Y., RADC, Jan. 1965 243 p
(Contract AF 30(602)-2976)
(RADC-TR-64-527; AD-610762)

The investigation is concerned with the interpretation of the readings taken on radar-type signals with field intensity meters (FIM). The investigation develops the theory of impulse noise calibration and then shows the relationship of noise calibration to pulsed rf signals. The relationship of field intensity meter bandwidth with respect to the pulse width of the rf signal is discussed. Recommendations are made concerning variable bandwidth. The relative merits of calibration sources are discussed. The feasibility of utilizing a pan-adapter to predetermine spectral content of signals prior to calibration of FIM is discussed. Author

N65-19178# Illinois Univ., Urbana.
STUDY AND INVESTIGATION OF MILLIMETER AND SUBMILLIMETER WAVE RECEIVER TECHNIQUES Fifth Quarterly Report, 1 Mar.–30 Sep. 1964
James E. Degenford Griffiss AFB, N.Y., RADC, Feb. 1965 20 p refs
(Contract AF 30(602)-3046)
(RADC-TR-64-551; AD-611536)

The development of video and superheterodyne detection techniques which are appropriate for the millimeter and submillimeter range of the spectrum is described. A crystal detector cartridge was constructed in which the whisker wire is formed into a loop so that the rf currents in the whisker wire are set up by coupling to the magnetic field of the incident wave. The loop detector is compatible with both the reflecting beam waveguide and conventional 4-mm waveguide. Construction details and preliminary test results are presented. Author

N65-19292# Illinois Univ., Urbana. Antenna Lab.
VLF TRANSMISSION PAST A SHORELINE
D. S. Karjala and R. Mittra Nov. 1964 14 p refs
(Contract AF 19(628)-3819)
(AFCRL-64-996; AD-610705)

The junction of two semi-infinte parallel impedance plane waveguides is used as a model for propagation past a shoreline. The problem is solved exactly for an arbitrary source by the mode matching technique. Explicit results are given for both the transmitted and the reflected fields at all points. Author

N65-19293# Illinois Univ., Urbana. Antenna Lab.
SCATTERING BY A SEMI-INFINITE IMPEDANCE STRIP IN A WAVEGUIDE Technical Report No. 4
D. S. Karjala and R. Mittra Nov. 1964 15 p refs
(Contract AF 19(628)-3819)
(AFCRL-64-999; AD-610702)

The problem of dominant mode scattering by a symmetrically placed impedance strip in a parallel plane waveguide is solved exactly. The mode matching technique used is considerably more straightforward than the Weiner–Hopf method, and is applicable to a number of other problems. Author

N65-19295# General Electric Co., Syracuse, N. Y. Electronics Lab.
INVESTIGATION OF AFCRL TRI-COORDINATE RADAR TECHNIQUE Final Report, Mar. 1962–Dec. 1964

Earl R. Wingrove, Jr. 15 Dec. 1964 158 p refs
(Contract AF 19(628)-335)
(R65ELS-26; AFCRL-65-8; AD-611802)

An experimental tricoordinate radar system was assembled. This report begins with an explanation of how the antenna converts elevation angle of arrival to an electrical phase difference, followed by a block diagram description of the complete radar. Then each of the units which make up the receiving system is individually discussed. The phase-stable limiting amplifiers, developed specifically for this application, receive particular attention. Next, a detail block diagram explanation of the indicating system is given, followed by descriptions of the indicator circuits. In each case, complete schematic diagrams are given, accompanied by sufficient information to permit operation and maintenance of the equipment. Preliminary testing of the system with an aircraft target has shown the feasibility of the concept, and the need for additional study. Author

N65-19296# Hughes Aircraft Co., Culver City, Calif.
OPTIMIZATION TECHNIQUES FOR ANTENNA DESIGN Final Report, 1 Mar. 1962–31 Dec. 1964
A. Ksienski and G. O. Young 31 Dec. 1964 14 p
(Contract AF 19(628)-333)
(P64-128; AFCRL-65-18)

This program of research aimed at the evaluation of antennas as information-gathering devices and entailed the development of techniques that would permit the comparative evaluation of linear, nonlinear, and nonreciprocal antenna systems. These objectives were achieved and the results reported in several scientific reports. Summaries of those reports are included in this final report. Author

N65-19299# System Development Corp., Santa Monica, Calif.
SPECIAL PERTURBATION TECHNIQUES APPLICABLE TO SPACETRACK
P. Chambliss, Jr. and J. Stanfield Bedford, Mass., AFSC, Electron. Systems Div., Jul. 1964 21 p refs
(Contract AF 19(628)-1648)
(TM-LX-145/000/00; ESD-TDR-64-533; AD-611283)

Three special techniques, variation of parameters, Crowell's method, and Encke's method are described, which can be specifically applied in the SPACETRACK system to determine the motion of an artificial satellite under the influence of perturbing accelerations. Author

N65-19315# Illinois Univ., Urbana. Digital Computer Lab.
NOVEL ELECTRO-OPTICAL LIGHT MODULATORS
Gabor Kalman Ujhelyi (Ph.D. Thesis) 26 Oct. 1964 97 p refs
(Contract Nonr-1834(15))
(Rept.-170; AD-609178)

A new intensity modulator, which operates on the principle of electrooptically controlled partial reflections, is described. The light beam to be modulated traverses a transparent isotropic material of index of refraction $n = n_1$ and is incident on the electro-optic material with $n = n_2$ ($n_1 > n_2$). The reflected amplitude depends on the index of refraction n_2, which in turn is controlled by the modulating electric field through the electro-optical effect. Also described is a beam direction modulation by controlled inhomogeneity. A variation of the index of refraction causes the light beam to change direction. Hence, the deflection of the light beam can be achieved by changing the index of refraction achieved by an electric field effect on a suitable electro-optical material. E.E.B.

N65-19341# Adelphi Univ., Garden City, N. Y. Dept. of Graduate Mathematics
MINIMUM-SCATTERING ANTENNAS
Walter K. Kahn and Herbert Kurss (Polytechnic Inst. of Brooklyn) Mar. 1965 16 p refs
(Grants AF-AFOSR-453-63; NSF GP-2761)
(AGM-121)

Antennas with identical radiation patterns can differ in the manner and extent to which they modify an incident wave, i.e., in the way they scatter. This paper enlarges on the work of Dicke on this subject, employing a scattering representation based on spherical modes. However, the approach is more physical and includes antennas with nonreciprocal components and with N(local) ports. A canonical minimum scattering antenna is defined as one which becomes invisible when the accessible waveguide terminals are open circuited. The scattering matrix of such an antenna is shown to be unique once N arbitrary orthogonal radiation patterns are specified. Neither an impedance nor an admittance matrix for such an antenna exists. It is demonstrated for a large class of antennas terminated by matched receivers that the scattered power is generally greater than the absorbed power, equality being attained for minimum-scattering antennas. Author

N65-19365# Stanford Research Inst., Menlo Park, Calif.
COMPARISON OF POWER SPECTRAL DENSITY TECHNIQUES AS APPLIED TO DIGITALIZED DATA RECORDS OF NONSTATIONARY PROCESSES, PART I
G. W. Evans II, G. L. Sutherland, R. C. Mc Carty, and P. H. Omlor Sep. 1963 150 p refs
(Contract ARPA SD-103; ARPA Order 281-62)
(TR-14; AD-419493)

This report contains a discussion of harmonic analysis, power spectral analysis, stationary and nonstationary stochastic processes, and a description of 27 techniques for power spectral density (PSD) analysis. A comparison is made of the results of applying these methods to simulated nonstationary radar backscatter signals, and conclusions are drawn as to which of the methods is the preferred PSD technique. The preferred technique is then used to analyze actual data from recordings of radar backscatter from missiles. Author

N65-19379# Naval Postgraduate School, Monterey, Calif.
BAND WIDTH OF A KNIFE-EDGE SCATTER CIRCUIT
David B. Hoisington Jan. 1965 14 p refs
(RR-50; AD-611124)

The bandwidth of a knife-edge scatter cricuit is estimated as a function of the antenna beamwidth. The knife edge is assumed to be located off to one side of a line between the transmitter and receiver, as in the Monterey–San Jose circuit, but to be in a plane with this line. It is shown that where the effective knife edge is small compared to the beamwidth, the signal may be completely canceled at the receiver. This cancellation can best be avoided by moving one antenna a lateral distance that is calculated. On the basis of the equations developed, the bandwidth between nulls of the Monterey–San Jose microwave circuit was calculated to be 2.6 Mc. The measured bandwidth was 3.4 Mc. Author

N65-19409# DECO Electronics, Inc., Boulder, Colo.
DYNAMIC ELECTRICAL MODELING OF ELECTRODES MOVING IN SEA WATER Interim Report
L. Ball Oct. 1964 24 p refs
(Contract Nonr-3387(00))
(IR-30-P-7; AD-609717)

This study has direct application to the design of submerged dipole antennas. The hypothetical laboratory modeling system consists of a closed circuit water tunnel capable of simulating the electrodynamic and hydrodynamic properties of water at speeds up to 20 knots. Electrical noise quieting is achieved by shielding and correlation techniques. Only the test section of the water tunnel is shielded. Additional quieting is obtained by using coaxial electrodes. The simulator features parametric control of fluid properties, corrosion rates, turbulence, fluid velocity, model shape, and materials. Author

N65-19420# Illinois Univ., Urbana. Electrical Engineering Research Lab.
RESEARCH STUDIES ON PROBLEMS RELATED TO ANTENNAS Quarterly Progress Report, 1 Jun.–31 Aug. 1964
James Rippin Nov. 1964 90 p refs
(Contract AF 33(657)-10474)
(QR-8; AD-610707)

Studies were made on *Radiation from Periodic Structures; Log-Periodic Cavity-Backed Slot Antennas; Log-Periodic Magnetic Current Antenna; Log-Periodic Zigzag Antennas; Logarithmic Spiral Antennas; Multi-Arm Logarithmic Spiral Antennas; An Integrated Antenna Amplifier; Periodic Structures for Wide Band Applications; Radiation Lens Illuminated From a Goubau Beam-Waveguide; Radiation from Circular Waveguides; Omnidirectional and Steerable Beam Antenna Development at Millimeter Wavelengths; Millimeter Antenna Test Instrumentation;* and *Components for Millimeter Wave Antennas.* G.G.

N65-19500# Bell Telephone Labs., Inc., Whippany, N. J.
ENGINEERING SERVICES ON TASK STUDIES OF MILITARY COMMUNICATION SYSTEMS: ELECTRICAL PROTECTION OF TACTICAL COMMUNICATIONS SYSTEMS Final Report
J. B. Hays and D. W. Bodle 1 Jul. 1964 314 p refs Reprinted
(Contract DA-36-039-SC-73089)
(TR-6; AD-224077)

The purpose of electrical protection and factors which need to be considered in establishing the protection requirements for communication systems are presented. Also discussed are sources and effects of abnormal potentials, electric shock hazards and various basic methods for reducing the possibility of trouble from such sources. Presented in detail is a variety of basic information required in the solution of electrical protection problems such as the nature and magnitude of lightning, surge propagation in communication plant, surge behavior of insulation, surge testing techniques, etc. Specific protection devices such as fuses, discharge gaps and semiconductor limiters are described. Data on their operating characteristics are also presented. Finally, the application of the principles and data on protective devices and methods presented in previous chapters is discussed. Several types of tactical systems are used as illustrative examples, included among which are a transistorized repeater, the spiral four system and a radio-multiplex system. Author

N65-19522# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
PROJECT WIDE BAND Final Report
Walter A. Flood Griffiss AFB, N. Y., RADC, 1 Nov. 1964 161 p refs
(Contract AF 30(602)-0277)
(CAL-UB-1363-P-6; RADC-TDR-64-461; AD-609619)

The results of a theoretical and experimental program to determine the influence of the atmosphere on radar resolution are presented. The limits imposed by the atmosphere on resolution in range, angle and velocity are treated theoretically, and estimated values are presented based on current experimental data. General expressions are derived which permit assessment of the atmospheric influence on resolution as a function of frequency. Consideration is given to multipath dispersion, phase fluctuations and unequal target cross sections. A description of a radio astronomy experiment, which was performed to deduce the phase fluctuations incurred by a wave traversing the ionosphere, is presented with the results obtained. Similarly an experiment performed to determine the tropospheric contribution to phase path fluctuations is presented along with a discussion of the validity of the data as limited by the measurement technique employed. An application of the data is included which provides an assessment of the influence of phase fluctuations on the performance of a focused, multiple antenna, communications system. Author

N65-19589# MITRE Corp., Bedford, Mass.
PULL-IN PERFORMANCE OF FIRST-ORDER PHASE-LOCKED LOOPS
Peter Bratt Bedford, Mass., AFSC, Electron. Systems Div., Feb. 1965 68 p refs
(Contract AF 19(628)-2390)
(W-06943; ESD-TDR-64-640; AD-611878)

A phase-locked loop is briefly described, together with the derivation of the basic differential equation which governs the dynamic behavior of the loop during the pull-in process. The special case of the pull-in process of the first-order loop when a sine wave of constant frequency is applied to the input of the loop is also described. The relationship between the frequency mistuning of the loop, the initial starting phase angle of the input sine wave, and the time required for the loop to pull in is discussed. The statistical parameters associated with the pull-in time are reviewed. In particular, expressions are given for the probability density function of the pull-in time and the cumulative distribution of the pull-in time. Author

N65-19609# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ADVANCED MOLECULAR SYSTEMS TECHNOLOGY. VOLUME I: SYSTEM APPLICATIONS
Dec. 1964 67 p
(Rept.-1909A)

This volume describes the developmental systems which have been molecularized, their performance, and their relation to future production systems. Systems described are (1) communications equipment, (2) radar systems, (3) electro-optical systems, and (4) computing systems. R.W.H.

N65-19622# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ENGINEERING Quarterly Progress Report, Division 7, 1 Sep.–30 Nov. 1964
J. F. Hutzenlaub 5 Jan. 1965 17 p
(Contract AF 19(628)-500; ARPA Order 498; ARPA Order 600)
(ESD-TDR-64-587; AD-609872)

Mechanical system testing, and radome and building construction are reported for the Haystack antenna project. The major portion of the optical instrumentation of the KC-135 aircraft has been completed. Progress is reported on fabrication and environmental testing of a series of experimental communications satellites. E.P.V.

N65-19635# Little (Arthur D.), Inc., Cambridge, Mass.
OPTIMUM SIGNAL DESIGN AND PROCESSING FOR REVERBERATION-LIMITED ENVIRONMENTS
H. L. Van Trees Oct. 1964 115 p refs
(Contract NObsr-81564; Proj. Trident)
(Rept.-1501064; AD-609589)

The problem of designing optimum signals and receivers for an active sonar system in a reverberation-limited environment is studied. A suitable model of the reverberation return is developed. The return is characterized as a zero-mean nonstationary Gaussian random process with a correlation function assumed to be known. The structure and resultant performance of the optimum and conventional receivers are derived. Some general signal properties useful in signal design are derived. Two cases are considered in detail: reverberation which is homogeneous in range and results in interference which is a stationary Gaussian process, and reverberation which is nonhomogeneous in range and results in a nonstationary Gaussian process. Author

N65-19649# France. Ministère de l'Air, Paris.
STUDY OF A DEVICE OF DECIMETRIC TYPE RADAR FOR PHASE COMPARISON. APPLICATION TO THE MEASUREMENT OF MAGNITUDE OF THE DISPLACEMENT OF WEAK AMPLITUDES HAVING A RAPID EVOLUTION IN TIME [ETUDE D'UN DISPOSITIF DU TYPE RADAR DECIMETRIQUE A COMPARAISON DE PHASE. APPLICATION DE LA MESURE A DISTANCE DE DEPLACEMENTS DE FAIBLES AMPLITUDES A EVOLUTION RAPIDE DANS LE TEMPS]
Michel Loyer Serv. de Doc. Sci. et Tech. de l'Armement, Jul. 1964 91 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 140

Displacement measurement is accomplished by determining the variation in the phase shift between the emitted wave and the wave reflected by a metallic reflector representing a moving point. The basic idea of measuring the phase shift consists of transposing the phase shift between the two waves to a much lower frequency where it is much easier to measure. Considerations of the amplitude and velocity of displacement and of the distance between the emitter and the reflector led to the choice of a 466 MHz emitter, pulse modulated at 1 to 4 μsec with a recurrence frequency of 10 kHz, and controlled by a 5.75MHz quartz oscillator. The trihedral reflector used is described, and the receiver characteristics are specified. The actual measurement of the phase shift is accomplished by an oscilloscopic procedure which, together with recording on film, gives the curve of displacement as a function of time. M.P.G.

N65-19681# ACF Industries, Inc., Paramus, N. J. Electronics Div.
FEASIBILITY ANALYSIS OF INFRARED DETECTION AND TRACKING OF LUNAR RETURN VEHICLE
19 Nov. 1964 25 p refs

Acquisition and tracking by infrared or optical means of a reentering Apollo vehicle will be desirable under certain conditions. The purpose of this report is to present a preliminary estimate of the target characteristics and problem geometry. The analysis was based on assumptions and estimates derived from previous reentry studies and on information contained in current open literature. Author

N65-19691*# Alabama Univ. Research Inst., Huntsville.
WAVE PROPAGATION IN GROOVE GUIDES
H. Y. Yee and N. F. Audeh [1964] 24 p refs
(Grant NsG-381)
(NASA-CR-57272) CFSTI: HC $1.00/MF $0.50

A groove guide consists of two parallel conducting plates with two grooves cut at the center in the longitudinal direction. The air filled deformed guide can be transformed into a parallel-plane guide filled with a nonuniform anisotropic dielectric. The posed boundary value problem was solved by approximation techniques; the results were experimentally verified. The groove guide has the advantages of transporting most of the energy in the groove region, having a very low attenuation constant and, under certain conditions, propagating the dominant modes only. Author

N65-19700*# National Aeronautics and Space Administration. John F. Kennedy Space Center, Cocoa Beach, Fla.
SATURN EARLY LAUNCH PHASE TRACKING BY CW DOPPLER
Lester F. Keene and D. B. Varnado 13 Apr. 1964 52 p refs
(NASA-TM-X-56203; SP-79) CFSTI: HC $3.00/MF $0.50

An experiment was conducted to determine the feasibility of using cw tracking systems for measuring vehicle position, velocity, and acceleration during the early launch phase. An analytical comparison has been made between one cw system and conventional optical data. Little difference was found between results given by the two systems. Least-squares fits show the cw system having somewhat smaller variations. Possible utilization of a close-in cw system is discussed. Author

N65-19738# Federal Aviation Agency, Washington, D. C. Communications Development Div.
REMOTE CONTROL AIR GROUND FACILITY MONITORING Final Report
Raymond R. Barkalow Feb. 1965 23 p refs
(RD-65-19)

The requirements of a fully effective remote control air-ground (RCAG) monitor are discussed, and a monitor meeting these requirements is described. Also described is a simple line monitor. A cost benefit analysis shows that over 75% of the total RCAG outages are attributable to the line, and that monitoring only the lines will result in a savings of approximately $61 000 annually in travel expenses. The analysis also shows that no savings can be effected by monitoring equipment at the RCAG facility and that to provide an effective RCAG monitor for operational purposes would be economically prohibitive. Author

N65-19745# Cubic Corp., San Diego, Calif.
FEASIBILITY STUDY FOR A VEHICLE ATTITUDE DETERMINING SYSTEM. VOLUME I: SYSTEM DESCRIPTION AND ANALYSIS Final Report
J. T. Baylor, R. J. Derenthal, J. C. Marlow, A. E. Noyes, L. B. Palmer et al Griffiss AFB, N.Y., RADC, Nov. 1964 213 p refs
(Contract AF 30(602)-3135)
(RADC-TDR-64-318, Vol. I; AD-603279)

A feasibility study to design a system for determining vehicle attitude by means of radio-frequency techniques was conducted, and various techniques to perform the attitude determination were evaluated. It was concluded that the use of an inverted interferometer with transmitter installed on the vehicle would meet the system requirements. Using at least two ground stations, the yaw, pitch, and roll axes of the vehicle can be measured to an accuracy of 0.1° during the early launch phase. In subsequent phases of flight the accuracy of yaw measurement is reduced. A detailed antenna analysis was provided, which estimates the magnitudes of the measurement errors contributed by the antenna baseline on the vehicle. The operation of the transmitting interferometer is examined in detail, and preliminary system design parameters are established. Recommendations are given for areas requiring further study. Author

N65-19760*# Michigan Univ., Ann Arbor.
MINIMUM-ERROR DEMODULATION OF BINARY PCM SIGNALS
Earl F. Smith (Ph.D. Thesis) 1963 134 p refs
(Grant NsG-2-59)
(NASA-CR-57350) CFSTI: HC $4.00/MF $1.00

Error probability is optimized in the study of demodulation of noisy, binary, pulse-code-modulated waveforms. The minimum-error demodulation operation was determined for waveforms with and without interbit dependence. The following assumptions were made: (1) Interbit dependence results from statistical dependence between data samples. (2) Demodulation decisions are made one word at a time but using statistically dependent, received noisy words. (3) Noise is independent of the transmitted signal and additive. (4) The number of words used is arbitrary. For independent, additive, band-limited white Gaussian noise, a method was developed for simulating with a digital computer the minimum-error demodulation with statistical dependence between data samples. Minimum error probabilities were then computed. E.E.B.

N65-19762*# General Electric Co., Daytona Beach, Fla. Apollo Support Dept.
INTEGRAL SENSOR TELEMETRY, PHASE A REPORT
12 Feb. 1965 91 p refs
(Contract NAS8-11715)
(NASA-CR-57307) CFSTI: HC $3.00/MF $0.75

Included in this study were the following: (1) definition of the system requirements and the generation of an equipment specification for five sensor transmitters; (2) evaluation of presently available sensor transmitters with respect to the specification; (3) definition of system requirements for an ultimate integral sensor system for factory vehicle checkout including propagation of sensor signals, electrically small antennas, transmitter power supplies, radiated rf energy as a power source, and remote control of transmitter radiation. It was concluded that the presently available transmitters would meet the specifications for the five transmitters. Author

N65-19763*# Michigan Univ., Ann Arbor.
ON THE MEASUREMENT AND USE OF TIME-VARYING COMMUNICATION CHANNELS
William L. Root [1963] 50 p refs
(Grant NsG-2-59)
(NASA-CR-57316) CFSTI: HC $2.00/MF $0.50

The beginnings of a theory are established concerning time-varying and random linear channels. The intent is to characterize classes of channels which can be determined exactly or approximately by measurement, showing how the measurements can be made, analyzing the errors, and applying the results to the theory of signal detection. The notion of a determinable class of channels is defined and general examples are given. These include classes of channels that are time-invariant, periodic, and which vary with a known trend. The measurement of slowly varying channels by approximation by time-invariant ones belonging to a known determinable class is discussed. Relation between almost-time-invariance of a channel and the correlation properties of a kind of stationary random channel are developed and tied in with the channel measurement theory. An application is made to the problem of detecting sure signals in noise when the channel is slowly varying. Author

N65-19793# EDO Corp., College Point, N. Y.
A STUDY OF SUPERGAIN ARRAYS Final Report
Alan Winder 7 Jan. 1965 34 p refs
(Contract Nonr-3346(00))
(Rept.-6756; AD-455624)

A supergain array is designed for maximum directivity index (MDI). For a linear array of N point elements spaced equally at integral half-wavelengths, with uniform, in-phase excitation, the MDI equals 10 log N. For element spacings less than one-half wavelength, MDI requires out-of-phase excitation and a relatively large range of amplitudes which must be controlled with extreme accuracy. The amplitude shading required for MDI in wideband reception may be determined by considering the space noise correlation function. The presence of self-noise in the individual elements of an array or their preamplifiers may seriously reduce the effective gain of the array designed for MDI. This degradation of performance is particularly enhanced if the amplitude shading of any of the elements is considerably larger than the overall value required for uniform shading. The synthesis problem for realizing supergain is discussed. Finally, the noise figure of a piezoelectric hydrophone–cable–amplifier circuit and the source impedance required to minimize it are calculated. Author

N65-19794# American Machine and Foundry Co., York, Pa. Product Development Dept.
ASR ANTENNA SYSTEM QUADRUPLE ROTARY JOINT ASSEMBLY: TYPE FAA/SRDS-108-31-4D Final Engineering Report, Jun. 28, 1963–Feb. 14, 1964
F. Briganti Jan. 1965 62 p refs
(Contract FA-WA-4649)
(RD-64-53)

The assembly includes an S-band high power channel and three L-band channels. The principle attribute of the S-band Channel is its high power handling capability and low VSWR. This channel was subjected to a high power test and breakdown occurred at 1.375 megawatts with no pressure, and at 2.71 megawatts maximum with 15-psi pressure. The specified requirement is 1.25 megawatts maximum with no pressure. The VSWR measured over the band on each unit is less than 1.135. The three L-band channels were subjected to a high power test and no breakdown occurred up to 100 kW with no pressure. The three L-band channels tested to a maximum VSWR of 1.2. A 67 dB minimum to 86-dB maximum isolation between channels was obtained compared to 60 dB maximum cross coupling specified between joints. The insertion loss of all channels varied from 0.07 dB minimum to 0.3 dB maximum compared to the specified maximum of 1 dB for the L-band channels, and 1.3 dB for the S-band channel. Insertion loss was kept to a minimum by the use of silver–graphite bushings to provide effective rf short circuiting and mechanical centering. Author

N65-19827 Lincoln Lab., Mass. Inst. of Tech., Lexington.
THE ESTIMATION OF A PULSE TRANSFER FUNCTION IN THE PRESENCE OF NOISE
M. J. Levin 9 Jul. 1962 24 p refs
(Contract AF 19(628)-500)
(Rept.-34G-8)

In this paper statistical estimation theory is applied to derive effective techniques for measurement of the pulse-transfer function of a linear system from normal operating records obscured by additive noise. The problem is equivalent to that of fitting a hyperplane to a set of observed points with random errors in certain coordinates. The methods of T. Koopmans are applied to obtain generalized least-squares estimates which are also maximum likelihood estimates when the noise is white and Gaussian. The estimates of the coefficients are obtained as the components of the eigenvector corresponding to the smallest eigenvalue of the matrix equation

$$[A - \theta_1 Z]\gamma = 0$$

Here Λ is a matrix of sample auto- and cross-correlation functions of the input and output records and Z is the covariance matrix of the corresponding noise components. Expressions for the sampling variances and bias are given. The properties of the simpler standard least-squares estimates are also considered. The appropriate modifications for nonwhite noise are described. Author

N65-19835# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
INVESTIGATIONS OF ADAPTIVE DETECTION TECHNIQUES Final Report, Aug. 1963–Aug. 1964
J. G. Lawton Nov. 1964 81 p refs
(Contract Nonr-3927(00))
(CAL-RM-1744-S-2; AD-609799)

The characteristics of adaptive signal detection and waveform estimation systems are determined. The signals of interest are pulselike, recur sporadically, and are masked by noise. The objective of the adaptive system is to detect and describe these signals without having detailed knowledge of their waveshapes, strength, signal-to-noise ratio or statistics of occurrence. A system is developed which determines the coefficients of an orthonormal expansion of its input waveform, decides at what instants a signal is most likely to be present, and builds up a description of the signal waveform. The best orthonormal expansion to use is determined by the statistics of the set of signals with which the system is to operate. An adaptive system, using a Laguerre expansion, was analyzed, and constructed and evaluated using analog computer and digital logic techniques. Results of the simulation show that it operates in accordance with theory and should be useful in defining the capabilities and limitations of such systems. Its performance is illustrated by means of plots and graphs. Author

N65-19853*# Stanford Research Inst., Menlo Park, Calif.
THE DESIGN OF AN EXPERIMENT TO DETERMINE THE LIMITATIONS IMPOSED ON A MULTIPLE-APERTURE ANTENNA SYSTEM BY PROPAGATION PHENOMENA Second Quarterly Report, 1 Sep.–30 Nov. 1964
J. H. Bryan, C. H. Dawson, F. G. Fernald, W. H. Foy, Jr., and J. Peschon [1964] 40 p refs
(Contract NAS5-3974; SRI Proj. 5067)
(NASA-CR-57398)

Work on the design of an experiment to determine propagation limitations on multiple-aperture antennas led to the following conclusions: (1) The signal platform should be a satellite in a nonequatorial circular orbit with a period of more than 10 hours. (2) A suitable beacon and/or transponder compatible with the NASA Minitrack or with established range, range-rate tracking systems should be provided. (3) Kalman filtering techniques at the receiving site should be able to provide range-rate data to the required accuracy. (4) The satellite should be able to transmit on any two of the frequencies 2, 4, 8, and 16 Gc simultaneously with coherent sidebands 100 or 200 Mc from each carrier. (5) A minimum of five antennas each with amplitude monopulse feeds and three front ends should be provided. (6) A minimum of two receivers should be provided, each having a sum channel, two angle-error channels, and two sideband channels. Author

N65-19854*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPUTATION OF WEIGHTED ROOT MEAN SQUARE OF PATH LENGTH CHANGES CAUSED BY THE DEFORMATIONS AND IMPERFECTIONS OF ROTATIONAL PARABOLOIDAL ANTENNA
Sandra M. Barondess and Senol Utku 1 Mar. 1963 23 p refs
(Contract NAS7-100)
(NASA-CR-57359; JPL-TM-33-118) CFSTI: HC $1.00/MF $0.50

Since the reflector itself and its supports are both flexible, the displacements under loads are partially caused by the displacements of the supports and partially by the distortions of the reflector. Previous work has shown that the root mean square of the change in the path length over the reflector surface is a measure of the magnitude of the interference taking place for wavelengths much greater than the expected maximum distortions of the surface. Mathematically this is a problem of eliminating the rigid body motion from the displacements of a surface and of varying a surface parameter such that the remaining distortions will minimize a specified function, which is formed by the sum of the squares of the normal distortions with certain known weights. This scheme is comparable to the general method of weighted residuals, where the distortions correspond to the residuals. The specified function is a quadric which is always positive. A digital computer program is developed to compute from the displacements both the new orientation of the best fit paraboloid and the associated root mean square. Author

N65-19864*# Philco Corp., Blue Bell, Pa. Research Labs.
MODULATION INDUCING RETRODIRECTIVE OPTICAL SYSTEM Technical Report, 21 May 1963–20 May 1964
Boyd Harned Sep. 1964 70 p refs
(Contract NASw-721)
(NASA-CR-57461) CFSTI: HC $3.00/MF $0.75

An investigation was conducted of the feasibility of an optical communications network making use of a passive modulation inducing device. The concept of MIROS, a Modulation Inducing Retrodirective Optical System, considers a passive element whose reflectivity changes in accordance with light of different frequencies and intensities so that the modulation of one beam is transferred within the element to another beam. Studies indicated that this system is feasible for long-distance communication, using laser sources, and also that a number of techniques are possible. A rate equation analysis of a simple three-level scheme in a two-photon absorption process shows that the frequency response for cross modulation eventually falls off as ω^{-1}, but that the onset of this falloff may be shifted in frequency with the proper choice of the two beam intensities in comparison with the system relaxation time. Experimental investigations were concerned primarily with the production of amplitude modulation effects in optical pumping of cesium vapor, but the possibility of using the Franz–Keldysh absorption band edge shift in semiconductor materials was also demonstrated. Four methods of producing cross modulation with optical pumping were developed, spanning the electromagnetic spectrum from audio to optical frequencies. Author

N65-19880*# Montana State Coll., Bozeman. Electronics Research Lab.
FM DEMODULATOR THRESHOLD REDUCTION Final Report
John Duncan Sep. 1964 87 p refs
(Contract NAS5-3616)
(NASA-CR-57496; ERL-B-009-623) CFSTI: HC $3.00/MF $0.75

A mathematical analysis is presented of the stochastic processes involved in the demodulation of a signal in the presence of band-limited white noise. This analysis results in an expression for the signal-to-noise ratio transfer characteristic of a conventional FM demodulator. The FM threshold is a function only of the demodulator input signal-to-noise ratio.

To reduce the threshold, it is necessary to use a form of predetection filtering to reduce the signal-to-noise ratio at the frequency discriminator input. Two controversial threshold reduction techniques, the Phase-Locked-Loop (PLL) and the Frequency-Compressive-Feedback-Loop (FCFL) demodulators are discussed. A third technique, the Frequency-Tracked-Filter is proposed and a limited investigation of its feasibility presented. While the idealized FCFL demodulator appears to offer excellent threshold reduction possibilities, several physical limitations severely restrict its capabilities. The PLL and Frequency-Tracked-Filter demodulators are not as susceptible to loop delays as the FCFL, and their control loops are not in the signal path. Author

N65-19890*# Alabama Univ., University. Bureau of Engineering Research
ELECTRONIC SCANNING AND BEAM SHAPING METHODS Technical Report No. 1
Harold Mott and David N. Mc Quiddy 15 Feb. 1965 69 p refs
(Contract NAS8-11295)
(NASA-CR-57458) CFSTI: HC $3.00/MF $0.75

The results of a study of the current literature concerned with electronic scanning of antenna arrays are presented. The present state of the various methods of beam scanning is discussed, and the advantages and limitations of each method for particular applications are outlined. Areas are pointed out in which additional studies are needed. Author

N65-19902*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIRBORNE TRANSISTORIZED TELEMETER SYSTEM MODEL SST-1
R. J. Stattel and J. E. Pownell Washington, NASA, Apr. 1965 34 p
(NASA-TN-D-2151) CFSTI: HC $2.00/MF $0.50

The SST-1 Telemeter System is a small, light, 16-channel, pulse-position/amplitude (PPM/AM) modulated system developed to replace the AN/DKT-7 telemetry transmitter. It is intended for use in small sounding rockets and is compatible with existing ground station facilities. Features discussed include low power consumption, component-type standardization, reduction of adjustment requirements, and reliability. Author

N65-19925*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SPACE PROGRAMS SUMMARY NO. 37-31, VOLUME III FOR THE PERIOD NOVEMBER 1, 1964 TO DECEMBER 31, 1964. THE DEEP SPACE NETWORK
31 Jan. 1965 105 p refs
(Contract NAS7-100)
(NASA-CR-57521; JPL-SPS-37-31, Vol. III) CFSTI: HC $4.00/MF $0.75

Work for this precision communication system was performed in the following areas: *Tracking Stations Engineering and Operations*—flight-project engineering, systems engineering and integration, systems analysis, Goldstone operations, and 85-ft antenna construction in Canberra; *Space Flight Operations Facility*—installation of orbit determination keyboard, and high speed data system for real time telemetry data transmission; *RF Systems Development*—development of two- and three-position waveguide systems; *Communications Engineering Developments*—S-band implementation, drift rate and stability of Mariner spacecraft oscillator, anechoic chamber facility, and klystron amplifier subassembly; *Communications Research and Development*—ground antennas, closed cycle refrigerator for masers, X-band radar thermal radiation measures of the moon; S-band planetary radar, error statistics of inter-DSN teletype channels, and experimental activities at Venus site operations; and *Advanced Antenna Systems*—progress on a 210-ft antenna for the Mars site of the Goldstone station. G.G.

N65-19930*# General Precision, Inc., Glendale, Calif. Research and Systems Center
STUDY ON SPEECH COMPRESSION FOR MANNED SPACE VEHICLES
20 Mar. 1964 118 p refs
(Contract NASw-700)
(NASA-CR-57405) CFSTI: HC $4.00/MF $0.75

The overall problem of voice communications over interplanetary distances is examined. Heuristic arguments are used to arrive at quantitative descriptions of poor, good, and excellent speech. These descriptions include the bandwidths and signal-to-noise ratios required for analog speech transmission systems of various qualities. In addition, they include the bit rate required for equivalent digital systems. On the basis of these descriptions, and through further heuristic arguments, estimates are arrived at for the theoretical limits on speech compression ratios. These limits are 300 for speech of good or telephone quality and 1500 for speech of excellent, or high-fidelity, quality. This is contrasted with compression ratios between 10-to-1 and 30-to-1 available with present systems. The power required for voice communication over interplanetary distances is examined both with communication equipment available in 1963 and with that which may be expected to be available after 1970. The results are said to establish the need for a drastic improvement in speech compression techniques if satisfactory voice communication is to be achieved with reasonable power levels. D.E.W.

N65-19972# Raytheon Co., Wayland, Mass. Advanced Development Lab.
NEWBURYPORT ANTENNA: TEST RESULTS Final Report
John E. Walsh and Neil F. Lacey Bedford, Mass., AFCRL, 1 Dec. 1964 32 p
(Contract AF 19(628)-496)
(AFCRL-64-987; AD-612789)

Calibration and testing procedures are described, with particular reference to patterns taken by focusing in the near field. Test results were encouraging but not conclusive, and emphasize the existence of major difficulties in the assessment of characteristics of directive antennas at frequencies below uhf. Author

N65-19980# Mitre Corp., Bedford, Mass. Telemetry Systems Subdept.
A STUDY OF NON-STANDARD TELEMETRY SYSTEM CHARACTERISTICS
A. T. Amrhein, comp. Sep. 1964 270 p refs
(Contract AF 19(628)-2390)
(ESD-TDR-64-155; AD-612076)

This phase of a two-phase program is to establish backup documentation for coping with a great number of the deviations from the Inter-Range Instrumentation Group (IRIG) telemetry standards. Data obtained from the Air Force, Army, Navy, and NASA relative to deviations from the standards are categorized and summarized. Modulation formats, as well as deviations in frequency division systems, time division systems, pulse code systems, and radio-frequency systems, are analyzed. Extreme deviations from the standards are covered under the general

heading of "Odd-Ball Requirements." Approximately 1000 deviations were found in 140 programs. Suggested revisions to the standards are made, and specific studies to be conducted in the second phase of this program are recommended. Author

N65-20014# Washington Univ., Seattle. Dept. of Electrical Engineering
THE MODIFIED ANGER AND LOMMEL-WEBER FUNCTIONS Technical Report No. 91
Yung-Sen Chen and Akira Ishimaru Nov. 1964 25 p refs
(Contract AF 19(628)-2763)
(AFCRL-64-969; AD-611415)

The modified Anger $J_{\nu,k}(Z)$ and Lommel-Weber functions $E_{\nu,k}(Z)$ encountered in the study of antennas and electromagnetic waves are defined. The differential equations satisfied by these functions, recursion formulas, and identities are derived. The series expansions, the asymptotic expansions for large arguments, and the integrals expressible in terms of these new functions are given. Author

N65-20032# Thomas (A. S.), Inc., Westwood, Mass.
THEORY OF GRADED RADAR ABSORBER MATERIALS Interim Engineering Report
C. M. Copenhaver and W. H. Mc Neill 15 Jan. 1965 69 p refs
(Contract AF 33(657)-11475)
(M63-1; AD-611336)

Expressions for the effective dielectric constant and magnetic permeability of an artificial dielectric consisting of a rectangular array of infinitely long circular rods are derived in terms of the spatial and electrical characteristics of the rods and the surrounding medium. The mean electromagnetic field in the dielectric, from which the effective dielectric constant and permeability can be deduced, is determined for the near-field case. Thus, the results apply for closely packed thin rods. The effective dielectric constant and magnetic permeability are given in terms of the rod diameter, rod spacing, dielectric constants and magnetic permeabilities of the rods and surrounding medium, and the wavelength of the incident wave. Author

N65-20060# Ohio State Univ. Research Foundation, Columbus. Antenna Lab.
DIFFRACTION BY A COAXIAL ARRAY OF METAL OR DIELECTRIC TOROIDS
Jack H. Richmond 9 Jul. 1964 36 p refs
(Contract AF 33(615)-1081)
(Rept.-1751-5; AD-447526)

The theory and equations are developed for the fields of a magnetic line source on the axis of an array of metal or dielectric toroids. The magnetic line source may have a uniform or nonuniform current distribution, and each toroid may have a different radius and dielectric constant. The cross-section radius of each conductor or dielectric is assumed to be small in comparison with the wavelength, but the radius of the toroid itself has no such restriction. Results are presented graphically for the far-field patterns of magnetic dipoles and line sources with metal and dielectric toroids. The solution takes into account the interaction effects among all the toroids in the array. One important application is to the design of dielectric rings for the correction of radome boresight error. As the dielectric constant is varied, the electric field intensity in the dielectric goes through a sharp maximum with a wavelength resembling that of a tuned circuit, even when the dielectric cross section is much smaller than the wavelength. The techniques developed here can be extended to obtain an accurate solution for the diffraction and boresight error of a conical radome. Author

N65-20061# Pennsylvania Univ., Philadelphia. Moore School of Electrical Engineering
STUDY OF METHODS OF IMPLEMENTING POYNTING VECTOR MEASUREMENTS Eighth Interim Report, Apr. 1–Jun. 30, 1964
Nabil Farhat, K. S. Foo, and R. M. Showers 31 Jul. 1964 38 p refs
(Contract NBy-32219)
(Rept.-65-07; AD-612675)

Results of a study to verify the feasibility of making Poynting vector measurements in the near field at 1 Mc are reported, new instrumentation and measurement techniques described, and the significance of the ground plane and its effect on the measurement discussed. Poynting vector measurement at 1 Mc was achieved either by measuring the loop and rod antenna output voltage (V_H and V_E) and the time phase between them separately, or directly by using a multiplier, from whose output a quantity proportional to the magnitude of the Poynting vector was derived. The results obtained using either method of measurement were in agreement with theoretical prediction. The ground plane under the Poynting sensor served only to eliminate the effects of the cables on the measurement and had no major effect on the final results. S.C.W.

N65-20112*# Hughes Research Labs., Malibu, Calif.
MULTIPLE ACCESS SATELLITE COMMUNICATION Final Report, 20 Aug. 1962–20 Aug. 1963
S. G. Lutz [1963] 74 p refs
(Contract NASw-495)
(NASA-CR-57530) CFSTI: HC $3.00/MF $0.75

Problems relating to future multiple-access satellite communications systems are studied. The work performed is classified in two categories: (1) frequency sharing—determining the antenna azimuth arcs of surface microwave stations permitting beamed interference with satellites in any given circular equatorial orbit; and (2) system—an orbital aspect of multiple access systems, and the overlap of coverage areas of two satellites as a function of their height and separation. An attempt is made to arrive at an antenna pattern approximation typifying an average microwave relay antenna and its usage, and to determine the relative importance of beam and sidelobe interference components at the satellite's receiver. It seems that a time-division multiple satellite system would need to offer compelling advantages, to be acceptable to the world's telecommunication industry. Since the satellite system will be a "common carriers' carrier," its competitiveness will depend on its cost compared with equivalent surface communication costs, without reference to the additional cost for user-to-station surface communication. R.W.H.

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N65-18626# Informatics, Inc., Sherman Oaks, Calif.
EXECUTIVE CONTROL PROGRAM (ECP-1A) Final Report, Feb.–Sep. 1964
Griffiss AFB, N.Y., RADC, Jan. 1965 273 p *its* Rept.-4-576-2
(Contract AF 30(602)-3045)
(RADC-TDR-64-460; AD-610817)

The first phase of the Executive Control Program developed for the experimental computing complex is described.

The complex consists of such things as multiple user consoles, multiprograming in one computer, multicomputers, and a variety of peripheral equipment from different manufacturers, all interconnected through an electronic switching network. Author

N65-18760 Joint Publications Research Service, Washington, D. C.
ON PERCEPTRON POSSIBILITIES
A. P. Petrov *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 103–115 refs (See N65-18751 09-34) CFSTI: $6.00

The results are presented concerning the study of a system, known as a "perceptron", which has the capacity of being taught recognition of certain geometric shapes. Using a perceptron model, the results of basic experiments are described. A theoretical analysis of a perceptron is presented for describing a class of problems; it is shown that a perceptron solves only those problems which can be solved by a simple superposition algorithm. Author

N65-18761 Joint Publications Research Service, Washington, D. C.
ON THE PROBLEM OF CREATION OF LEARNING AND SELF-TEACHING AUTOMATIC CONTROL SYSTEMS
L. N. Volgin *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 116–121 refs (See N65-18751 09-34) CFSTI: $6.00

Work done on solving the problem of constructing universal teaching and self-learning automatic control systems which use the theory of pattern recognition is reported. Its purpose is to develop the construction principles for similar systems. As the use of interpolation between patterns is new for the theory of recognition, it is clear that in many recognition problems, where the concept of pattern conveys a significantly discrete nature, such interpolation is in principle impossible. However, in automatic control problems where the concept of pattern is used as a synonym for operator experience and control capacity, it is relevant. Author

N65-18762 Joint Publications Research Service, Washington, D. C.
PROBABILITY ANALYSIS OF COMBINATION SYSTEMS AND THEIR RELIABILITY
V. I. Levin *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 122–130 refs (See N65-18751 09-34) CFSTI: $6.00

It is shown that correct combination systems may be broken into a series of sequentially united steps. According to the probability distribution of the input of the system, probability distribution of the output and probability of correct operation of the system are found. Author

N65-18764 Joint Publications Research Service, Washington, D. C.
ON DYNAMIC PROPERTIES OF DIGITAL CONTROL MACHINES WHICH USE THE INCREMENT PRINCIPLE
G. Kh. Babich and Yu. V. Kovachich *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 147–164 refs (See N65-18751 09-34) CFSTI: $6.00

The dynamic properties of a special class of digital control circuits—so-called increment computers (IC)—are investigated. It is shown that an IC is a nonlinear device and has nonlinearity of the saturation type at the input. The dynamic properties are investigated both in a linear and in a nonlinear region. Criteria are introduced for calculation of nonlinear distortions in an IC. Author

N65-18765 Joint Publications Research Service, Washington, D. C.
USE OF A DIRECT LYAPUNOV METHOD IN THE SOLUTION OF PROBLEMS OF NON-LINEAR PROGRAMMING
M. V. Rybashov and Ye. Ye. Dudnikov *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 165–174 refs (See N65-18751 09-34) CFSTI: $6.00

A procedure is proposed for solution of a simultaneous system of nonlinear inequalities. According to the initial system of inequalities based on the direct Lyapunov method, a special gradient system of differential equations is constructed. Theorems are formulated for establishing convergence of the solution. Use of the direct Lyapunov method permits presentation of proof without using widely known conditions of convexity of the initial function, i.e., it permits investigation of a wider class of systems limited only by conditions of applicability of the correct Lyapunov method. Author

N65-18793# Argonne National Lab., Ill.
NEARREX, A COMPUTER CODE FOR NUCLEAR REACTION CALCULATIONS
P. A. Moldauer, C. A. Engelbrecht, and G. J. Duffy Dec. 1964 42 p refs
(Contract W-31-109-ENG-38)
(ANL-6978) CFSTI: $2.00

This program for computing energy averages of integrated compound nucleus scattering, capture, and fission cross sections was developed gradually over several years as an experimental code used in part to test theoretical ideas and numerical methods, and in part to conduct a continuing program of neutron-cross-section calculations for purposes of reactor design and research. While the program still bears some marks of its long history of modifications, adaptations, and enlargements, it is now sufficiently compact and unified to make it generally available for cross-section computation. Author

N65-18795# Case Inst. of Tech., Cleveland, Ohio. Systems Research Center
A HEURISTIC APPROACH TO SOLUTION OF CHECKERBOARD PUZZLES
Gilbert J. Hansen [1964] 94 p
(Grants AF-AFOSR-125-63; NSF GP-658; NSF GP-642)
(SRC-49-A-64-16; AFOSR-64-2406; AD-609570)

The problem of reconstructing a checkerboard cut into a number of straight edge pieces was solved by a digital computer program employing a variety of heuristics. The major heuristics used were considerations of the symmetry of the pieces, correct color combinations, optimal selection of the place on the board to fit the next piece, the optimal piece to select at each stage, pairing of the pieces, and selecting the first piece. These heuristics were applied to simulate as closely as possible the way in which a human being would proceed in obtaining a solution. The number of tries necessary to obtain a solution were minimized, thus making the solution time reasonable. Two 8 × 8 checkerboard puzzles were tried. The first consisted of 12 pieces and was solved in 8 minutes. The second had 13 pieces and took 1 hour and 25 minutes. Author

N65-18822* National Aeronautics and Space Administration, Washington, D. C.
COMPUTATION OF PERFORMANCE BY USE OF A DIGITAL COMPUTER
Masaru Watanabe and Michiko Okamoto *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 144–154 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Flow chart is presented for computer calculation of rocket trajectories. Due to points of discontinuity in thrust change during the beginning and completion of propellant combustion, changes in variables cannot be accurately determined around the ends of the trajectory; the program is designed to eliminate these errors by constructing the time intervals so that the discontinuous points coincide with the interval beginnings. Computations show improved precision under this method. J.M.D.

N65-18861# Stanford Research Inst., Menlo Park, Calif.
FUNCTION MODELING EXPERIMENTS
R. O. Duda, J. W. Machanik, and R. C. Singleton Dec. 1963 73 p refs
(Contract Nonr-3438(00))
(AD-427018)

Trainable machines built of threshold logic units having adjustable weights can be used to approximate or model complicated functions of several variables. The input to the machine is a coded version of the independent variables, and the machine output is a coded version of the dependent variable. The machine is trained by iteratively adjusting the weights to obtain good approximations on a representative body of data. Several series of experiments in modeling functions with trainable machines are described in this report. Included are descriptions of prediction experiments, where the functions being approximated are subject to random fluctuations. The results of these experiments are compared with the results obtained by more conventional mathematical techniques. Author

N65-18957*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IBM 1401 SELECTIVE TAPE TO CARD. AOPB SYSTEMS MANUAL, PROGRAM DESCRIPTION
Patricia Ann Savage Aug. 1964 11 p
(NASA-TM-X-55169; X-542-64-261) CFSTI: HC $1.00/MF $0.50

The object is to punch one 80-character card image per record of those records of any Binary Coded Decimal (BCD) tape specified by the user. This program is written in Symbolic Programing System (SPS) for the IBM 1401. Input cards are punched in the described format to select those records of the BCD tape to be punched on card. The BCD tape remains unaltered. The output is punched cards. The records of the tape are taken to be consecutively numbered starting with the number 1 and going up to (potentially) 99999. Author

N65-18964# Air Force Systems Command, Bedford, Mass. Electronic Systems Div.
CORTEX: A COMPUTER-BASED SYSTEM FOR AIDING DECISION MAKING
Emir H. Shuford Dec. 1964 42 p refs Presented at the 2nd Congr. on the Inform. System Sciences Also Published in "Inform. System Sciences: Proc. of the 2nd Congress" Washington, D.C., Spartan Books, 1965
(ESD-TR-64-677; AD-610121)

Decision theory is the contemporary manifestation of the mathematics of the decision process and thus can be viewed as a primary aid to the human decision process. The costs and gains of applying the concepts and algorithms of decision theory are considered in some detail. A man–computer system is described which is designed to make the concepts and algorithms of decision theory available to a decision maker at a greatly reduced personal cost. The decision maker needs no knowledge of computer programing and a minimal knowledge of decision theory and mathematics in order to begin using the system in his day-to-day decision-making activities. Author

N65-18968# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
DECOMPOSITION AND STATE ASSIGNMENT FOR SEQUENTIAL MACHINES
Zvi Kohavi 19 Aug. 1964 38 p refs
(Contract AF 49(638)-1402)
(PIBMRI-1231-64; AD-609253)

A system of sequential machines can be significantly reduced if a method of factoring some small machines connected in cascade to other machines and producing the desired response can be found. Necessary and sufficient conditions are developed for two (or more) machines to be cascade decomposable in such a way that both have one common component machine that may be factored and shared by the two machines. To obtain the common machine the concept of implication table is introduced. The implication table is shown to be the state table of the factored machine. It is further shown how machines that do not obey these conditions can be augmented in such a way that the conditions are satisfied and the factoring is possible. The problem of reducing the output circuit is also considered. The main tools in this point are the output consistent partitions and the partitions with substitution property of the partition pairs. The importance of a simplified output circuit is increased in the treatment of multiple outputs. Mealy-type machines. As a more advanced step, a new concept of partially independent subsets is studied. For machines that do not have any partition with substitution property or partition pairs it is shown how to obtain simpler assignments and output circuits with reduced dependencies by recognizing the partially independent subsets. Author

N65-19009# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
PROGRAMMING UNDER UNCERTAINTY: AN EXPERIMENTAL CODE FOR THE "COMPLETE" PROBLEM Mathematical Note No. 378
David Kohler (California Univ., Berkeley) and Roger Wets Dec. 1964 43 p refs
(D1-82-0391)

It is convenient from a computational point of view to assume that the coefficients of a linear programing problem are exactly known. However, the resulting solution can differ widely from the true optimum because some or all of these coefficients may, in fact, be random variables. The complete problem in programing under uncertainty takes into account the possibility of overestimating or underestimating the requirements and penalizes the oversupply or undersupply. This paper describes the problem, presents two examples, outlines the mathematical aspects of an algorithm, and finally gives the write-up and the features of an experimental code written for the IBM 7090 or 7094. Author

N65-19024# Radio Corp. of America, Princeton, N. J. RCA Labs.
ACTIVE LOGIC ELEMENTS USING NON-GALVANIC MODIFYING INPUTS Final Report, 1 Jul. 1962–30 Sep. 1964
G. Herzog, K. C. Hu, and M. H. Lewin 31 Oct. 1964 34 p refs
(Contract AF 19(628)-1629)
(AFCRL-64-896; AD-610395)

A general interconnection scheme which can be modified at the convenience of the user is sought with emphasis on arrays of active elements using nongalvanic modified inputs. An array of 128 insulated-gate field-effect transistors (IGFET) of the metal-oxide-semiconductor (MOS) type was assembled together with photosensitive control of signal paths. Sixty-four of the MOS transistors act as NOR logic gates; the remaining 64 MOS transistors act as on–off switches in series

with the signal path, and are controlled by photosensitive elements stimulated by a light pattern. The photosensitive elements in the present array are cadmium sulfide photoconductors fabricated on ceramic plates, but work was done on cadmium telluride high-voltage photovoltaic films intended for use directly on the substrate of the active logic elements. Cadmium telluride films deposited on glass produced voltages as high as 400 volts per centimeter. Although the films have an internal impedance of about 10^{10} ohms per square, the much higher input resistance of the MOS transistor, approximately 10^{14} ohms, permits physically small photovoltaic film elements to control the gate potential of an MOS transistor. Author

N65-19120# Army Electronics Labs., Fort Monmouth, N. J. Data Div.
ON THE RELATIONSHIP BETWEEN AUTOMATIC PROGRAMMING FUNCTIONS AND COMPUTING SYSTEMS
Robert M. Dunn Dec. 1964 13 p
(ECOM-2541; AD-611278)

Automatic programing is defined as the process of using a computer to accept sophisticated procedural descriptions as data in order to produce machine-executable sequences of instructions as answers. The translation, memory allocation, and diagnostics functions of automatic programing compose an interface between the computing system and the user. The library of subroutines available through automatic programing acts as an extension to the computer system. Ability to accept a variety of programing languages, data structures and subroutines provides flexibility to the computing system. Although techniques of automatic programing will change, the functional relationship to the computing system will remain the same. Author

N65-19171# Space Technology Labs., Inc., Redondo Beach, Calif. Physical Research Div.
THE TRW TWO-STATION, ON-LINE SCIENTIFIC COMPUTER Final Report, Jul. 14, 1963–Jul. 14, 1964
G. J. Culler, B. D. Fried, E. C. Field, and D. Pope Griffiss AFB, N.Y., RADC, Dec. 1964 326 p refs
(Contract AF 30(602)-3097)
(STL-8587-6002-RU-000; RADC-TDR-64-392; AD-609720)

The research and development of on-line techniques and their application to problem solving are described. The computational aspects of the multidimensional problem (a nonlinear diffusion equation) are summarized. The physical significance of this problem and a discussion of the results obtained are given. A general description of the on-line system from the user's viewpoint, including some elementary examples of the constructive aspects of on-line computing is presented. The on-line problem-solving techniques developed in this program involve a blending of numerical and mathematical analysis somewhat different from that generally encountered in conventional computing, being best characterized as emphasizing a global rather than a local approach to problem formulation and solution. A complete user's manual for the present system is included, and a detailed description of each of the basic programs is given. The detailed information needed to use this system is provided. Author

N65-19221# Iowa State Univ., Ames.
RESEARCH ON ANALYSIS OF VARIANCE AND RELATED TOPICS Final Technical Report
G. Zyskind, O. Kempthorne, R. F. White, E. E. Dayhoff, and T. E. Doerfler Wright-Patterson AFB, Ohio, ARL, Nov. 1964 229 p refs
(Contract AF 33(616)-8269)
(ARL-64-193; AD-612035)

A detailed account of the randomization consequences in a generalization of the balanced incomplete block design, and a unified formulation of experimental structures are given. Variance analysis in the general experiment is discussed, as is the application of generalized polykays to the obtaining of variances and covariances of components of variation. The size and power of certain tests under experimental randomization are considered. Author

N65-19298# Mitre Corp., Bedford, Mass.
DESCRIPTION OF THE SYSTEMS DESIGN LABORATORY DISPLAY CONSOLES
Jonathan Mitchell Bedford, Mass., AFSC, Electron. Systems Div., Feb. 1965 55 p
(Contract AF 19(628)-2390)
(TM-03930; ESD-TDR-64-150; AD-611753)

Six display consoles were purchased to facilitate rapid, accurate communications between data processing facilities and display operators. These consoles may be connected to any computer able to control IBM 729 series magnetic tape drives. Each console contains a 2048-word magnetic core memory for storing display data coded in a highly efficient manner. It also contains display storage in the form of a 64-frame film strip any frame of which may be presented on the display. Display generation is very rapid and capable of showing alphanumeric and special characters, straight lines, and points. The appearance of a number of the special characters is under control of the data processor's program. The display operator is provided with switches, a light pencil, and a typewriter able to generate inquiries or statements for entry into the data processor's program. Author

N65-19300# Massachusetts Inst. of Tech., Cambridge. Engineering Projects Lab.
HUMAN USE OF SHORT TERM MEMORY IN PROCESSING INFORMATION ON A CONSOLE
Bernard P. Zeigler and Thomas B. Sheridan Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1964 47 p refs
(Contract AF 19(628)-3317)
(ESD-TDR-64-620; AD-609749)

It is assumed that an operator's console constitutes a third form of memory in addition to that integral to the human and that integral to the machine not directly accessible to the human. Questions are raised concerning the characteristic modes of human storage and retrieval of information from internal memory when such external memory is accessible. Storage structures characterizing internal human memory and external console memory in this task are postulated. A retrieval model implied by these structures is constructed to account for the effects of computation and learning upon the features of the experimentally obtained curves. Insufficient retrieval of required information from internal memory is assumed to necessitate external memory search. Computation increases the probability of insufficient retrieval and hence the frequency of external search. Learning decreases this probability. The effects of inducing alternate forms of internal storage are studied and found generally to result in increased storage and retrieval times. Author

N65-19320# Bendix Corp., Baltimore, Md. Bendix Radio Div.
IN-FLIGHT DECISION SYSTEM Quarterly Report
31 Dec. 1964 42 p
(Contract NOw-64-0448-d)
(QR-2; AD-454521)

A system for the automatic detection of targets in clutter or camouflage background to provide information suitable for missile terminal guidance systems is presented. Inflight decision system, computer studies, analog recognition, recognizer theory, and neural networks are included. Major effort is being devoted to problems of property filters and transformation of parameter fields. R.W.H.

N65-19330# National Reactor Testing Station, Idaho Falls, Idaho.
A TRANSISTORIZED BIDIRECTIONAL DECADE COUNTER
K. D. Smith Jan. 1965 20 p refs
(Contract AT(10-1)-205)
(IDO-17059) CFSTI: $1.00

A transistorized bidirectional decade counter utilizing a binary and a quinary circuit is described. The elimination of feedback requirements, the minimization of the readout logic, and the symmetrical properties of the 10 logical states produce an attractive counter. The logical design of the device is presented. The electrical equivalent circuit of the quinary is analyzed in detail, and the conditions necessary for successful operation are described. Author

N65-19370# Michigan Univ., Ann Arbor. MTI Radar Lab.
A SIMPLE DEVICE FOR AIDING THE PROGRAMMING OF THE LGP-30 DIGITAL COMPUTER
William D. Becher Feb. 1965 23 p refs
(Contract DA-28-043-AMC-00013(E); Proj. Michigan)
(Memo-6400-15-R; AD-457197)

The device, similar to a circular slide rule, is described. It facilitates program time optimization, bit weighting and binary point location, and binary-hexadecimal-decimal conversion. In addition, frequently needed tables are printed on the aid. Full-scale reproductions of the aid scales are included to permit easy construction. Author

N65-19382# Massachusetts Inst. of Tech., Cambridge.
THE MAC SYSTEM Progress Report
R. M. Fano 9 Oct. 1964 26 p refs Presented at the Symp. on Computer Augmentation of Human Reasoning, Washington, D.C., 16 Jun. 1964 Submitted for Publication
(Contract Nonr-4102(01); Proj. MAC)
(MAC-TR-12; AD-609296)

The notion of machine-aided cognition implies an intimate collaboration between a human user and a computer in a real-time dialog on the solution of a problem, in which the two parties contribute their best capabilities. For this intimate collaboration to be possible, a computer system is needed that can serve simultaneously a large number of people, and that is easily accessible to them, both physically and intellectually. Author

N65-19388# Florida State Univ., Tallahasee. Dept. of Statistics
SEQUENTIAL RANK TESTS. I: MONTE CARLO STUDIES OF THE TWO-SAMPLE PROCEDURE
Ralph A. Bradley, Donald C. Martin, and Frank Wilcoxon Nov. 1964 35 p refs
(Contract Nonr-988(08))
(M-60; ONR-TR-15; AD-610459)

Monte Carlo studies of a sequential, two-sample, rank-sum test developed earlier by Wilcoxon, Rhodes, and Bradley are reported. Ranking is accomplished within groups of observations in the sequential procedures, and the theory is based on a model suggested by Lehmann. Design parameters are α and β, probabilities of Type I or Type II errors, m and n, the numbers of X- and Y-observations in a group of observations, and k_1, the power in the Lehmann model wherein the alternative hypothesis states that the cdf of the Y-population is $G(u) = F^{k_1}(u)$, F(u) being the cdf of the X-population. Studies are made for designs with $\alpha = \beta = 0.05$, $m = n = 2(1)5$, and $k_1 = 1.5, 2.33, 4$, and 9. Data appropriate to the Lehmann model are generated, and studies are also made when $G(u-\mu_y) \equiv F(u)$. Average sample numbers and powers of tests are estimated. The effects of truncation are examined. It is concluded that the Monte Carlo results substantiate the use of the usual Wald theory of sequential analysis and that the use of the sequential methods for data from normal populations differing only in locations is satisfactory for most practical applications. Author

N65-19460# Los Alamos Scientific Lab., N. Mex.
SMOOTHING AND MULTIVARIABLE INTERPOLATION WITH SPLINES
T. L. Jordan 10 Mar. 1965 23 p refs
(Contract W-7405-ENG-36)
(LA-3137)

This paper gives the mathematical basis for smoothing and two-dimensional interpolation procedures on the IBM 7094 and 7030 computers. The one-dimensional spline is redefined in a new and concise notation that extends to the two-dimensional case. A smoothing procedure using splines is given. A two-dimensional interpolation procedure, of class C^2, based on one-dimensional splines is presented. A general extension to higher dimensional interpolation as an extension of the procedure for two-dimensional interpolation is outlined. Author

N65-19481# Auerbach Corp., Philadelphia, Pa.
INTERVIEW GUIDE HANDBOOK
8 May 1964 52 p
(Contract ARPA SD-219)
(AD-601259)

Instructions are given for conducting interviews with personnel selected at random for a study on how scientists and engineers acquire and use information. The study concentrates on identifying the information used by the person in performing a specific task, and also on estimating the information the person thought he wanted, whether or not the wants were actually fulfilled. The conceptual model of the acquisition of scientific and technical information that was used to structure the questionnaire is discussed. A sample questionnaire is given, and the specific information desired in each section of the questionnaire is explained. M.P.G.

N65-19498# Michigan Univ., Ann Arbor. Information Systems Lab.
A STUDY OF ITERATIVE CIRCUIT COMPUTERS Final Report, Oct. 1961–Dec. 1963
Harvey L. Garner, Rodolfo Gonzalez, Sandra Palais, Thomas F. Piatkowski, and Jon S. Squire Wright-Patterson AFB, Ohio. AF Avionics Lab., Apr. 1964 321 p refs
(Contract AF 33(657)-7391)
(AL-TDR-64-24; AD-601212)

This research investigated the problems and possibilities generated by the idea of a computer built as an iterative array of elementary self-contained processors. The following areas of study were treated in detail: (1) programing aspects—decomposition of a program to obtain maximum concurrency, a translation algorithm to facilitate programing, and algorithms for path-building; (2) proposed organizations—a multilayer computer, and an iterative circuit computer with n-dimensional

geometry; (3) statistical evaluation of accessibility for different geometrical structures; (4) reliability problems and new possibilities; (5) a theoretical model, linking the iterative circuit computer structure to that of an n-head automaton. Author

N65-19514# Israel Inst. of Technology, Haifa.
ANALOGUE ELECTRONIC REPRESENTATION OF STEREOSCOPIC VISION AND OF THE GEOMETRY OF MULTIDIMENSIONAL SPACES Final Scientific Report and Appendix
F. Ollendorff, E. Hirsch, G. Friedman, and L. Shaudinishky 31 Aug. 1964 250 p refs
(Contract AF 61(052)-551)
(AFCRL-65-89; AFCRL-65-89-A; AD-611371)

A geometrical analog electronic computer is studied, whose function can be defined as mapping of an n-dimensional space into an m-dimensional one with $n \geq m$. Its mathematical and electronic principles are discussed, including advantages and limitations. Author

N65-19524# Columbia Univ., New York. School of Engineering
MARKOVIAN DECISION MODELS FOR REJECT ALLOWANCE PROBLEMS Technical Report, Jul.–Sep. 1964
Morton Klein 1 Dec. 1964 28 p refs
(Contract Nonr-266(55))
(TR-24; AD-609677)

Most manufacturing processes produce some defective items. To compensate for this, the total quantity produced in attempting to satisfy an order is larger than the order size. The excess is called a reject allowance. It is shown how the Markovian decision framework can be used to determine the amount to produce when production is, or can be, divided so that the products can be inspected before the production run is ended. Author

N65-19532# Budd Co., McLean, Va. Information Sciences Center
STUDY OF PICTORIAL DATA ANALYSIS CONCEPTS AND TECHNIQUES Final Report, 1 Apr. 1963–30 Apr. 1964
Azriel Rosenfeld, Charles Fried, and James Prevel 31 May 1964 106 p refs
(Contract AF 49(638)-1231)
(AFOSR-64-2529; AD-609711)

The problem of developing rules for subdividing complex pictures into uniform regions is discussed. Experiments are described in which rules of this type applicable to one-dimensional pictures are derived from an analysis of observers' subdivision preferences. Author

N65-19570# RAND Corp., Santa Monica, Calif.
APPLICATIONS OF A DIGITAL-COMPUTER SIMULATION OF A NEURAL NETWORK
Donald H. Perkel 31 Dec. 1964 29 p refs Presented at the 2d Cybernetic Sci. Symp., Los Angeles, 13 Oct. 1964
(Grant NIH GM-09608-03)
(AD-609681)

A physiological model in which the neuron is composed of a soma and one or more fibers is discussed. The soma constitutes the spike-initiating locus of the cell, and postsynaptic phenomena are referred to their effects on that locus. The computer program that embodies the model is written almost entirely in Fortran IV, and operates on the IBM 7044 computer. The program has the capacity for 350 components; the partitioning among sources, somas, and fibers is specified in the input data. E.E.B.

N65-19606# California Univ., Berkeley. Electronics Research Lab.
TECHNIQUES FOR AUTOMATING THE CONSTRUCTION OF TRANSLATORS FOR PROGRAMMING LANGUAGES
W. H. Wattenburg 13 Jan. 1964 21 p refs
(Grant AF-AFOSR-139-63/139-64)
(Rept.-64-45; AD-609487)

Methods of building new computer program translators from programs which already exist are discussed. The general bootstrap procedure is described, in which the compiler for a specific computer accepts a program in a new symbolic language and converts it into a program that can be executed by that machine. A new development of this concept is presented: a compiler can be devised which will translate its own input programs—or input in some other language—into a program which can be used by another computer. An example is included, in which the existing Fortran compiler for the IBM 7090 is combined with an intermediate language to construct a Fortran compiler for the CDC 3600. J.M.D.

N65-19614# Lincoln Lab., Mass. Inst. of Tech., Lexington.
ALGORITHMS FOR ESTIMATING A RE-ENTRY BODY'S POSITION, VELOCITY AND BALLISTIC COEFFICIENT IN REAL TIME OR FOR POST FLIGHT ANALYSIS Group Report 1964-64
F. C. Schweppe 3 Dec. 1964 48 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-583; AD-609524)

A general theory of recursive estimation is applied to the particular problem of estimating the time history of a reentry vehicle's position, velocity, and ballistic coefficient from radar measurements of range, elevation, azimuth, and range rate. The resulting algorithms are conceptually simple and easy to implement on either general purpose or special purpose computers; are noniterative; and have storage requirements independent of amount of data. They are extremely fast, capable of real-time operation; and have a finite memory span, i.e., they can act like a sliding arc algorithm. Explicit formulas are provided along with general discussions on the basic concept. Author

N65-19627# RAND Corp., Santa Monica, Calif.
A DYNAMIC PROGRAMMING APPROACH TO THE NONPARAMETRIC PROBLEM IN THE CALCULUS OF VARIATIONS
Leonard D. Berkovitz and Stuart E. Dreyfus Dec. 1964 41 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4329-PR; AD-609649)

An approach to the nonparametric simple problem of the calculus of variations that is in the spirit of dynamic programing is presented. Under the assumption that the functions that define minimizing curves exhibit a certain regularity in their behavior, differentiability properties of the optimal value W are determined. Then the fundamental partial differential equation of dynamic programing is obtained, and the necessary conditions of the calculus of variations, with the exception of Jacobi's condition, are deduced as immediate corollaries. Author

N65-19633# System Development Corp., Santa Monica, Calif.
GENERAL-PURPOSE DISPLAY SYSTEM
S. L. Kameny, G. P. De Florio, and A. H. Vorhaus 23 Sep. 1964 24 p refs
(SP-1688; AD-451859)

A method for operating and developing information systems is described. It centers around a display console through

which user and computer communicate via a number of graphic input devices. The system starts with an initial set of approximately one dozen programed processes which provide the basic data storage, retrieval, and display operation. The computer queries the user as to his needs, and through his answers new computer-controlled processes are developed. J.M.D.

N65-19668# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
TIME-VARIABLE TIME DELAY FOR ANALOG COMPUTER SIMULATIONS
R. A. Walker Dec. 1964 28 p
(Contract AT(45-1)-1350)
(HW-83092, Rev.) CFSTI: $2.00

A time-variable time delay system was designed and built that accepts analog signals in the range of 0.0 to −10 V and delays them from 15 to 150 sec. The control voltage for determining the time delay period must be in the range of 0.0 to +10 V. Author

N65-19735# Oak Ridge National Lab., Tenn. Neutron Physics Div.
A GENERALIZED ONE-CONSTRAINT LAGRANGE MULTIPLIER NUMERICAL FORMULATION
F. H. S. Clark and F. B. K. Kam. Mar. 1965 42 p
(Contract W-7406-ENG-26)
(ORNL-3742) CFSTI: $2.00

The one-constraint Lagrange multiplier problem has been written for the CDC-1604 computer in a Fortran program called MAX. The program can deal with a combination of any varied and any constraining function which depend on no more than 18 independent variables and for which all second derivatives exist throughout the domain. The user is required to write two subroutines: one defines the varied function; the other, the constraining function. The computational method used is absolutely nondivergent, but for some starting values in some problems it will stop in the neighborhood of an extraneous point and require a restart at a different point. A test problem is included. Author

N65-19828# Stanford Univ., Calif. Dept. of Civil Engineering
METHODS FOR EXTENDING THE RANGE OF NON-COMPUTER CRITICAL PATH APPLICATIONS
John W. Fondahl Nov. 1964 187 p refs
(Contract NBy-45818)
(TR-47; AD-454007)

The use of time–cost tradeoffs, resource allocations, and further detailed analysis of the basic problem of extending the range of noncomputer critical path applications are discussed. Schedule updating and diagram revision procedures for networks in the category of 100 activities or less that can be extended to networks of larger size are described, and the data requirements for 6 applications of critical path techniques are presented. G.G.

N65-19877*# General Electric Co., Schenectady, N. Y. Ordnance Dept.
ANTENNA NOISE TEMPERATURE STUDY BY COMPUTER Monthly Progress Report No. 6, Dec. 1964
C. C. Allen [1964] 7 p ref
(Contract NAS5-3909)
(NASA-CR-57500) CFSTI: HC $1.00/MF $0.50

The initial test case used to check out the secondary pattern and gain program was a theoretical primary feed pattern, having uniform amplitude over the reflector illumination angle $2\psi_{max}$ and zero amplitude elsewhere. An f/D of 0.424, a frequency of 122.5 Mc, and polarization for a horn feed were used so that results could be compared directly with the H-plane pattern. Initial results indicated excellent agreement for the main beam and the first few side lobes out to about 30°, but considerable difference occurred for angles greater than 30° even though the pattern remained well defined. The phase function used in the present computer program was examined. Also the computer programing for the composite antenna pattern was completed and checkout started. Completion of the basic design of the experimental feed for scale model tests was also announced. E.E.B.

N65-20019# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW COMPUTERS
V. I. Loskutov 2 Mar. 1965 12 p Transl. into ENGLISH from Liteynoye Proizv. (USSR), no. 6, 1964 p 19–22
(FTD-TT-64-928/1+2; AD-611862)

The electronic computer, Minsk-2, is described. The computer is designed in units for assembly flexibility to satisfy the greatest number of requirements. The machine is adapted for solving systems of algebraic, differential, and integral–differential equations, matrix systems, and other operations which are required in scientific and engineering research. The machine consists of a central control desk, a device for introduction of information from a perforated tape, a central computing and local control unit, the operative accumulator on ferrites, rapid-action numerical printing device, external memory device, two input perforators for paper tape, a device for the preparation of the output data, and a device for printing documents. Operation of the computer and advance modifications are included. E.E.B.

N65-20021# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EMPLOYMENT OF ELECTRONIC DIGITAL COMPUTERS IN STRUCTURAL MECHANICS
A. P. Filin 1 Mar. 1965 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 2, 1964 p 188–192
(FTD-TT-64-951/1; AD-611859)

A report is given on papers presented in December 1963, at a conference in Leningrad on the use of electronic digital computers in structural mechanics. Papers given at one plenary session were concerned with modern computers and potential hardware developments, computer techniques, finite differential methods of equation solving, algorithmic languages, and problems of programing. Papers given at the other plenary session were about the static linear and nonlinear theory of plates and shells, problems of beam oscillations, impacts and oscillations of elastic bodies, and the development of a wide class of computer programs for various structures. D.E.W.

N65-20027# Scientific-Atlanta, Inc., Atlanta, Ga.
PRECISION ANTENNA PATTERN RECORDING TECHNIQUES, PHASE II
Jack B. Chastain, J. Searcy Hollis, Samuel F. Hutchins, and Rezin E. Pidgeon, Jr. Griffiss AFB, N.Y., RADC, Feb. 1965 22 p ref
(Contract AF 30(602)-3425)
(RADC-TR-64-541; AD-612058)

A study and investigation was made to prove the feasibility of precision amplitude- and angle-measuring devices, combined with sophisticated recording and display techniques, for antenna pattern measurements. This includes development of a stabilized transmitter, a precision, high data rate receiver

and associated equipment, and continuation of the theoretical investigation. Author

N65-20080# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DATA SYSTEMS Quarterly Progress Report, Division 2, 1 Aug.–31 Oct. 1964
7 Dec. 1964 21 p refs
(Contract AF 19(628)-500)
(AD-609005)

Summaries are given from research groups in the fields of digital computers, computer components, psychology, and control research. Some of the subjects discussed are optical input, symbolic page-address transformation, integrated circuit development, uhf switching transistors, flip-flop transistor memory storage, magnetic film engineering, and programing applications. Electron transport phenomena and film-memory sense amplifiers are also discussed. Automatic procedure executor and human information process programs are described. Advances are reported in on-line data processing, hybrid computer development, and estimation and control theory. E.P.V.

N65-20106*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
STUDY OF METHODS FOR THE NUMERICAL SOLUTION OF ORDINARY DIFFERENTIAL EQUATIONS Final Report, 9 Nov. 1963–8 Nov. 1964
H. L. Durham, Jr., O. B. Francis, Jr., L. J. Gallaher, H. G. Hale, Jr., and I. E. Perlin [1964] 289 p refs
(Contract NAS8-11129)
(NASA-CR-57430) CFSTI: HC $6.00/MF $1.50

The methods used were the single step lie series, the multistep Cowell, the multistep Adams, the single step Runge–Kutta–Fehlberg, and the single step Runge–Kutta–Shanks methods. Each method is discussed in detail, and all were applied to the restricted three-body problem. In particular, Arenstorf orbits of the restricted three-body problem were used. Error in the methods was checked by noting the degree to which the initial conditions failed to be reproduced at the end of one complete period. Programs for each method were written in double precision floating point arithmetic (23 decimal places) in extended algol for the B5000. A series of runs were made on three different Arenstorf orbits at various orders from 7 to 18 accuracies from 10^{-12} to 10^{-16}. These results are presented. The conclusions reached were that each of the methods, except that of Cowell, could be considered effective, but those of Runge–Kutta–Shanks and Runge–Kutta–Fehlberg were the best. At the highest accuracies and orders, where Runge–Kutta–Shanks formulas are not available, the Runge–Kutta–Fehlberg method was superior. Author

N65-20116# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AUTOMATIC COMPUTATION OF CORRELATION FUNCTIONS IN THE CASE OF NONUNIFORM TRAVEL OF SIGNAL-CARRYING TAPE
G. O. Ball 11 Aug. 1964 19 p refs Transl. into ENGLISH from Avtomatika (USSR), no. 3, 1963 p 47–58
(FTD-TT-64-294/1+2; AD-604342)

The systematic error of the correlator due to rate of motion fluctuations of the signal carrier is discussed. Also, questions regarding the effect of these fluctuations on the performance of the correlator and random correlator error are mentioned. It was shown that periodic carrier rate fluctuations lead to linear distortions of correlator error. Formulas, evaluating the correlator error, are developed. E.E.B.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N65-18620# Vitro Labs., Silver Spring, Md.
CIRCUIT MTTR AS A FUNCTION OF DESIGN Final Report, 19 Mar. 1963–30 Jun. 1964
Ralph G. Stokes Griffiss AFB, N. Y., RADC, Dec. 1964 84 p
(Contract AF 30(602)-3033)
(RADC-TDR-64-308; AD-610736)

The purpose of this study was to refine a maintainability prediction technique and to provide criteria for design for high maintainability at circuit level. The influence of pertinent design features was studied and relationships between maintainability and circuit design was given in terms of mean time to repair (MTTR). These MTTR terms were presented so as to permit quantitative prediction of maintainability for any circuit configuration of any circuit studied. Results of the program included 53 numerical values of MTTR as related to 8 design variables. A procedure was developed using the above results to estimate the expected maintainability for any combination of the eight design variables for any circuit function in any equipment type. Author

N65-18622# International Business Machines Corp., Bethesda, Md. IBM Federal Systems Div.
INTEGRATED SWITCHING AND MULTIPLEXING
P. O. Dahlman, K. M. Roehr, P. M. Thrasher, and R. J. Ward Griffiss AFB, N. Y., RADC, Oct. 1964 72 p refs
(Contract AF 30(602)-3086)
(RADC-TDR-64-329; AD-610464)

The goal was to determine the feasibility of integrating time division switching and frequency division multiplexing into a common operation, in lieu of effecting each as separate processes. The basis of this technique is a unique heterodyning scheme, which operates in conjunction with a generalized concept of resonant transfer. Further analysis of the fundamental idea is included, leading to the formulation of useful basic design criteria, and the reduction to practice of an experimental system to prove the feasibility. The results indicate that the method is entirely feasible. Author

N65-18625# Raytheon Co., Waltham, Mass. Research Div.
HIGH FREQUENCY TUNNEL DEVICE STUDY Third Quarterly Report
S. R. Steele and A. Starr Griffiss AFB, N. Y., RADC, Dec. 1964 32 p refs
(Contract AF 30(602)-3249)
(RADC-TDR-64-449; AD-610781)

The results of dc life tests performed upon a large number of devices showed mean currents varying by as much as a hundred from device to device. When the results are plotted as the logarithm of the sandwich-current and emission-current densities against the logarithm of time, the resulting curves are often so similar that they can be approximately superimposed if the axes are translated by suitable amounts. The current transferred through the thin insulator films, operated with a constant applied voltage, typically rises in the early stages of life, similar to the effect observed in BeO. The hypothesis that this is due to a change in the barrier is strengthened by the behavior of the voltage dependence of the emission current

as a function of time. The increase in sandwich current observed near the end of life appears to be due to a leakage current resulting in low-energy electron transfer from the aluminum to the gold, since the emission current is not affected. The leakage current shows a nonlinear dependence upon voltage. Author

N65-18627# Stanford Univ., Calif. Microwave Lab.
MULTIMEGAWATT BROADBAND MICROWAVE TUBES Quarterly Status Report No. 11, 1 May–31 Jul. 1964
Marvin Chodorow Griffiss AFB, N. Y., RADC, Dec. 1964 35 p refs
(Contract AF 30(602)-2575)
(RADC-TDR-64-465; AD-610066)

The centipede circuit was adapted for use on the electron stick so that the amplitude and phase of the growing wave along the beam–circuit interaction length can be measured. Tests on the electron stick for the suppression of parasitic oscillations were conducted. By covering the entire stick with a thin sheet of directionally resistive mylar, oscillations were removed, up to 30 kV. Two other sources of instability were found and removed: feedback oscillations and monotron oscillations. Work on calibration of external load and saturated-beam measurements is described. Studies on space-charge waves in an accelerated parallel-flow electron beam in a constant magnetic field have continued. The major emphasis was on the analysis of the second-order differential system; a discussion of the solutions for certain conditions is presented. Author

N65-18628# General Electric Co., King of Prussia, Pa. Spacecraft Dept.
ACCELERATED TESTING OF HIGH RELIABILITY PARTS First Interim Technical Report, 10 Jun.–10 Oct. 1964
T. M. Walsh, H. S. Endicott, G. Best, G. Bretts, H. Lampert et al
Griffiss AFB, N. Y., RADC, Jan. 1965 95 p refs
(Contract AF 30(602)-3415)
(RADC-TDR-64-481; AD-610943)

A review of data and information gathered during previously conducted accelerated test programs has led to the formulation of degradation models for the parts under study. Long term constant stress tests, which were inactive for a 9-month period after accumulating 5000 to 9000 hours of test time at various stress conditions, were restarted. The effect of the passive period on the long-term part parameter trends is discussed. Accelerated step-stress test designs and analysis plans were formulated for metal film resistors and semiconductors, and step-stress tests were initiated. Failure mechanism studies led to (1) the formulation of a current-conduction model for glass dielectric capacitors; (2) the detection, possible source and estimated effects of phosphorous compounds on surface leakage of transistors; and (3) low temperature characterization of diode surface leakage currents. Author

N65-18631# Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
FIELD TEST AND EVALUATION OF A HELIX OPEN PERIODIC FILTER
John J. Mc Cabe Jan. 1965 24 p ref
(RADC-TR-64-559; AD-610840)

Analysis of the data indicates an infinitely wide stop band with a minimum attenuation of 50 dB and observed rejections as high as 70 dB. Pass band data indicate a loss of less than 0.4 dB and a VSWR of less than 1.6:1 across most of the pass band. The filter was capable of accommodating the full output power (minimum of 2 MW) of the AN/FPS-65 at all frequencies. The filter tested demonstrated the feasibility of using open periodic structures for high power microwave filtering and their advantages over currently used techniques. Author

N65-18700# Sperry Rand Research Center, Sudbury, Mass.
A STUDY ON P-N JUNCTION PHOTODETECTORS UTILIZING INTERNAL PARAMETRIC AMPLIFICATION Third Quarterly Report, Period Ending 31 Dec. 1964
David E. Sawyer [1964] 14 p refs
(Contract N600(19)-61770)
(SRRC-RR-65-5; AD-610824)

Edge-illuminated silicon photodiodes were designed and constructed by saw-cutting cube from diffused, multilayered epitaxial silicon. This multilayered epitaxial silicon device can be used either as a conventional photodiode or as a photoparametric diode, and was used for the detection of light (6328 Å) modulated at frequencies as high as 8 Gc. A degenerate photoparametric amplifier for signal frequencies of 0.496 and 0.775 Gc was constructed and showed a power gain of about 25 dB with an optical signal modulated at 0.496 Gc. A face-illuminated unit in a DC-18 coaxial package was used as the photoparametric diode. A nondegenerate photoparametric amplifier has been designed and constructed that will allow use of either the face-illuminated encapsulated devices or the edge-illuminated device. The epoxy sealing of the encapsulated devices is being replaced with a metal-sealing technique using pure indium. G.G.

N65-18774# ITT Industrial Labs., Fort Wayne, Ind.
RESEARCH AND DEVELOPMENT TO IMPROVE THE RESOLUTION OF IATRON DIRECT VIEW STORAGE TUBES, PHASE II Interim Development Report, 2 Sep.–2 Dec. 1964
R. W. Hunter 6 Jan. 1965 13 p Prepared for Bureau of Ships *Its* Ser. 3308
(AD-609744)

Improvement in resolution of Iatron direct view storage tubes was achieved by reducing the transit time of electrons in the viewing screen-to-backing electrode space. This increase in resolution is limited by the gradient which can be established between the viewing screen and the backing electrode without voltage breakdown. Also, it was observed that the collector-to-backing electrode spacing seems to have had little direct effect upon the stored resolution. However, it may be a factor in moire patterns which influence the low brightness resolution. No change in resolution was obtained with change in insulator thickness. The design of an improved writing gun was reported. E.E.B.

N65-18792# Weapons Research Establishment (Australia).
A CIRCULAR TO RECTANGULAR WAVEGUIDE TRANSITION MAINTAINING A CONSTANT CUTOFF WAVELENGTH
J. R. Pyle Sep. 1964 15 p refs
(PAD-94)

A circular-to-rectangular waveguide transition is described. The transition maintains a constant cutoff wavelength equal to that of the fundamental wave (TE_{11}) in circular waveguide. The parameters of the variable cross section throughout the transition are computed and normalized to the radius of the circular waveguide. Author

N65-18882# General Electric Co., Palo Alto, Calif. Tube Dept.
RADIATION EFFECTS ON MICROWAVE DEVICES Final Report, 16 May 1963–15 Jul. 1964
R. A. Magnuson [1964] 68 p refs *Its* Rept.-4
(Contract DA-36-039-AMC-02293(E))
(TIS-R64ELM248-4; AD-457366)

This report summarizes a study conducted on the effects of radiation on traveling-wave tubes. The instrumentation system used to monitor the tube parameters is discussed. The C-band, permanent-magnet focused, low-noise TWT's that were tested are described. The test results obtained during three test series conducted at the Sandia Pulsed Reactor Facility (SPRF) are included. It was found that the output power of the tubes decreased by 6 to 10 dB on the first burst of each day. The power returned to the preburst value within 500μsec after the start of a 40-μsec halfwidth radiation pulse. The power decreases were reduced on succeeding bursts if the tube were not turned off between bursts. Possible failure mechanisms which could cause the power output decrease are discussed. Author

N65-18926# Rome Air Development Center, Griffiss AFB, N. Y.

STATE OF THE ART OF RECTANGULAR WAVEGUIDE RESONANCE ISOLATORS AND DIFFERENTIAL PHASE SHIFT CIRCULATORS

Joseph M. Schenna Dec. 1964 57 p refs
(RADC-TDR-64-487; AD-610761)

This report describes briefly the classical theory of operation of both the ferrite rectangular waveguide resonance isolator and the ferrite differential phase shift circulator. Theoretical expressions and related graphs are presented which are useful in making a comparative evaluation of ferromagnetic materials and predicting the approximate performance of one material when the performance of another is known. Some of the variable properties of useful ferrite and garnet materials are discussed and presented in graphical and tabulated form. Typical state-of-the-art characteristics of rectangular waveguide resonance isolators and differential phase shift circulators are tabulated as a function of frequency. A brief discussion is given relative to the development of the first low-frequency, high-power, 3-port waveguide circulator. Author

N65-18948*# United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.

NONDISSIPATIVE DC TO DC REGULATOR-CONVERTER STUDY First Quarterly Report, 15 Jun.–15 Sep. 1964

R. Donner [1964] 48 p refs
(Contract NAS5-3921)
(NASA-CR-57174; HSER-3037) CFSTI: HC $2.00/MF $0.50

This report includes a literature search for all known transistorized concepts of dc to dc conversion, a classification of all known concepts into five basic types of converters, a selection of the basic concept to be used for further study, an examination of duty ratio and power stage drive considerations, a preliminary investigation of power source and load considerations, a search of vendor literature for applicable high-speed transistors and rectifiers, and a preliminary investigation of applicable magnetic materials. The most promising mechanization appears to be a combination of pulse and frequency modulation, where pulse width is automatically set by the input voltage, and frequency is varied as a function of load. From a transistor efficiency viewpoint, the upper frequency of operation for the study is limited to 20–30 KCPS because of duty cycle restrictions. Power source and load considerations were examined briefly. The variation of pulse width as an inverse function of input voltage allows the power stage and output filter to suppress the specified input variations. Author

N65-18980# Northeastern Univ., Boston, Mass.

INVESTIGATION OF SOLID STATE DEVICES AND CIRCUITS Final Report

Basil L. Cochrun, ed. 30 Sep. 1964 22 p refs
(Contract AF 19(604)-7271)
(AFCRL-64-902; AD-609674)

This program was concerned with the development of tunnel diode circuitry and an experimental and theoretical investigation of semiconductor devices and characteristics. The application of tunnel diodes to linear circuits such as amplifiers, oscillators and negative resistance filters was investigated. Consideration is also given to their use in pulse circuits. Studies of the properties of conventional and unconventional junctions were made. Special semiconductor devices were fabricated and evaluated. Such devices include thin-film tunnel triodes and a unipolar field effect transistor. Author

N65-19014# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.

HYDROGEN CLEANUP

Sol Schneider, John E. Creedon, and Norman L. Yeamans Nov. 1964 19 p refs
(ECOM-2528; AD-611277)

In hydrogen-discharge experiments and in the design of hydrogen-filled devices, the influence of the discharge on the equilibrium state of the hydrogen–metal system in the container requires careful consideration. Contrary to normal expectations, the heat of the discharge does not increase the observed molecular gas pressure according to the equations of state for homogeneous systems. Instead, a temporary pressure decrease occurs. The phenomenon has been studied in several structures. The discharge parameters were varied from steady state to very narrow pulse conditions over a wide range of voltage and current. Analysis of the data reveals that an intimate relationship exists between the power dissipated in the discharge and the establishment of a new equilibrium state for the hydrogen-metal system. Spectroscopic measurements show that this is due to the generation of atomic hydrogen in the discharge and that the anomalous behavior is due to a depletion of the atomic gas. Author

N65-19015# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Dept.

INDUCTANCE EFFECTS IN ENERGY DIVERTER DISCHARGE CIRCUITS

George W. Taylor and Sol Schneider Nov. 1964 14 p refs
(ECOM-2529; AD-611276)

The effectiveness of energy-diverter protection can be reduced by the presence of inductance between the energy diverter and the "protected system." Two primary effects caused by inductance were noted. The first effect occurs when the fault-sensing circuit triggers the energy diverter during a high-impedance fault. In this case a large voltage oscillation about the zero reference level appears at the "protected system." If the inductance is large, the oscillation will be maintained for a long period and will prevent quick removal of voltage. The second effect occurs when the fault-sensing circuit triggers the energy diverter during a low-impedance arc. In this case the large inductance retards arc quenching. As the arc attempts to quench, the voltage oscillation reappears because of the energy stored in the inductor, and arc quenching is prevented. Observations on a system and an analysis of the circuit are discussed. Author

N65-19034# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DEPENDENCE OF ELECTRODE EROSION UPON FORM OF CURRENT PULSE

A. I. Kruglov and V. N. Fukin 28 Jan. 1965 16 p refs Transl. into ENGLISH from Elektroiskrovaya Obrabotka Metallov, Izd. Akad. Nauk SSSR, 1963 p 29–37
(FTD-TT-64-857/1+2; AD-611075)

The theory of electrode erosion as a function of the pulse form of an electrical current, description of apparatus for the experimental investigation of this phenomenon, and results obtained are reported. The dependence of erosion of copper anode and cathode on pulse amplitude is graphically represented, and the characteristics observed are explained by the theory of Zolothykh. E.E.B.

N65-19066# Sperry Gyroscope Co., Great Neck, N. Y. Radiation Div.
CIRCUITED AMPLIFIER DEVELOPMENT Final Report
Griffiss AFB, N. Y., RADC, Jan. 1965 134 p refs
(Contract AF 30(602)-3102)
(EB-5296-0542; RADC-TDR-64-497; AD-611270)

The development of an inexpensive circuited amplifier chain has been investigated. The chain is to be capable of peak power outputs of up to 100 kW at uhf (432 Mc) with broadband (40 Mc) capabilities. Flatplate and stripline cavity construction, and new techniques in fabricating inexpensive dc blocks and bypass capacitors were investigated. Tube types were evaluated for life and performance versus cost tradeoffs. Ease of maintenance coupled with high component and amplifier reliability were major points of consideration. All unique features and technical advances were oriented to be compatible with mass production techniques providing phased-array cavity hardware at minimum cost. Author

N65-19068# Lowell Technological Inst. Research Foundation, Mass.
EFFECTS OF EXTERNAL FORCES ON VIBRATING CRYSTAL PLATES Sixth Quarterly Report, 1 Aug.–31 Oct. 1964
Charles R. Mingins, Robert W. Perry, and Luther C. Barcus [1964] 43 p refs
(Contract DA-36-039-AMC-02239(E))
(Rept.-14; AD-657169)

Investigations are reported dealing with the reaction of quartz crystal plates while in stimulated oscillation to steady longitudinal stresses, especially of a tensile character. Under tension, BT-cut piezoids have frequency deviations opposite in sign to those experienced under compression, and the deviation vs azimuth curve is inverted. The AT plates driven in overtone modes under tension give curves which do not differ much from those produced in their fundamental modes. Experiments in which the behavior of the tensile stress coefficient of frequency is investigated over a range in diameter to thickness ratio extending from 52 to 160 are reported. Data are presented in a study of the effects of clamping pressure at different azimuthal angles. Further experiments are described on the nature of the force field set up in a plate under a variety of tensile stress cases. Preliminary results are reported involving temperature changes attendant upon the application of colinear forces. Three new and simpler frequency deviation equations in terms of nonlinear coefficients are deduced on the basis of the symmetry of the functions obtained from sixth-rank tensor transformations and the fit found to experimental results. Author

N65-19084# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A DIRECT CURRENT AMPLIFIER FOR PHOTOELECTRIC PHOTOMETRY
Ch'uan-Chin Wang 2 Feb. 1965 11 p refs Transl. into ENGLISH from T'ien Wen Hsueh Pao (China), v. 11, no. 1, 1963 p 74–78
(FTD-TT-64-828/1+2+3+4; AD-611047)

A direct current amplifier circuit with the following characteristics is reported: gain approximately 35; no appreciable nonlinearity for input voltages lower than 0.3 volts; drift less than 0.6 mV/hour; drift error not greater than 2.5% for currents of 2×10^{-12} amperes; and preoperational warmup not to exceed 1 hour. E.E.B.

N65-19105# MacLeod Instrument Corp., Fort Lauderdale, Fla.
DIGITAL SELECTOR SWITCH Final Summary Report
Maurice Lefra 12 Oct. 1964 29 p
(Contract DA-01-009-AMC-87(A))
(Rept.-7; AD-608669)

This report presents the significant technical information accumulated over an 8-month interval during which components were evaluated and tested, and feasibility models were designed and constructed. An engineering survey was initially conducted and its findings indicated glass reed-type switches well suited for this application. The first design considerations were to determine the ideal switch sensitivity, permanent magnet strength and minimum allowable spacing between adjacent switches. A series of experimental tests were conducted and the values for switch and permanent magnet combination were determined. Thirty test modules were fabricated; each module housed five reed switches and served as switch holder during environmental testing. The switches were subjected to vibration, high–low temperature and thermoshock environmental testing. Various packaging concepts were investigated and number of feasibility models were fabricated to test these concepts. Author

N65-19111# Melabs, Palo Alto, Calif.
INVESTIGATION OF MICROWAVE NON-LINEAR EFFECTS UTILIZING FERROMAGNETIC MATERIALS Quarterly Progress Report, Jul. 8–Oct. 16, 1964
Lee F. Donaghey [1964] 21 p refs
(Contract DA-36-039-SC-89206)
(QPR-10; AD-458221)

The design of a parametric amplifier utilizing a TE_{11n} dielectric ferrite resonator in a dielectric loaded, cylindrical waveguide is discussed, and experimental results from three resonators under parallel pumping in pulsed and quasi-cw modes are reported. Amplification is found possible only near $\omega = \gamma (H_0 - \frac{4}{3}\pi M)$ within a particular coalescence of spin modes. Comparison is drawn between the cylindrical waveguide geometry and the amplifier geometry utilizing a fine wire bias in the pump circuit. Author

N65-19113# Tung-Sol Electric, Inc., Bloomfield, N. J. Electron Tube Div.
ELECTRON TUBES RADIATION RESISTANT PILOT LINE PRODUCTION Quarterly Progress Report, 1 Jun.–31 Aug. 1964
F. B. Parks and John Grimm 30 Sep. 1964 54 p ref
(Contract DA-36-039-AMC-01476(E))
(QPR-5; AD-611556)

Production of 6080WB, 6360, and 6205 tubes in alumino-silicate glass stems and bulbs has continued. Also, 5886 tubes have been prepared by means of pinch-press sealing. High-temperature life testing (500° C bulb temperature) has continued on the 6080WB alumino-silicate tubes, 8 having now

successfully completed 500 hours of operation. Ten conventional glass 6360 tubes were high-temperature life tested to destruction. The test then started on 6360 and 5886 tubes of alumino-silicate glass, and both are now continuing. The 1000-hours steady-state nuclear radiation exposure test has commenced on representative samples of all four tube types (40 tubes, total). Considerable engineering effort was devoted to the problem of obtaining better yields on the 5886 and 6205 types. Author

N65-19115# Clevite Corp., Palo Alto, Calif. Shockley Research Lab.
NEW CONCEPTS FOR SOLID STATE MICROWAVE GENERATORS Quarterly Report, 1 Apr.–30 Jun. 1964
R. M. Scarlett [1964] 29 p refs
(Contract DA-36-039-AMC-00001(E))
(Rept.-6; AD-453126)

The impurity profile through the base layer of an n-p-n transit-time device was measured. This profile is relatively flat in a region near the emitter, so little built-in field exists there. Calculations are presented to show that this region of low field seriously degrades the current gain magnitude at large phase angles, leading to a smaller negative resistance effect. The first-order theory of a new amplifying device, termed the Surface Controlled Avalanche Transistor, is presented. This device appears promising as a microwave amplifier up to several Gc for relatively high power. Initial experimental devices performed approximately as expected, with no decrease in transconductance evident at 500 Mc. Better packaging is needed for higher frequency measurements. Author

N65-19118# Bendix Corp., Southfield, Mich. Research Labs. Div.
EXPLORATORY DEVELOPMENT OF THE Q-FACTOR TECHNIQUE First Quarterly Progress Letter, Period Ending 30 Jun. 1964
Max Frank 10 Jul. 1964 71 p refs
(Contract AF 29(601)-6316)
(Rept.-2645; AD-608959)

Results are presented of two gamma radiation tests performed to study gain degradation of the 2N1613 and 2N2378 silicon transistors under various operating and measurement conditions. The damage is analyzed using the Q-factor technique of series testing and linear damage variations with flux. Base transit time measurements are used to correlate differences in gain damage rates with differences in base geometry and doping between transistors of the same type. The damage constants derived from the radiation tests were found to be dependent upon the particular set of irradiation and measurement conditions employed. Author

N65-19137 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY IN SELF-BALANCING BRIDGES
V. V. Anokhina and V. I. Sergeyev *In its* Proc. of the Machine-Control Inst. 23 Nov. 1964 p 1–13 refs (See N65-19136 09-10)

The stability in self-balancing bridges was solved on the basis of a number of general assumptions associated with the stability of a nonlinear system with respect to its linear model. It is shown that the nonlinear systems will be stable in the region which comprises the set of points inside the surface of the ellipsoid V = constant tangent to the plane Σ_1 = constant. Further, the dynamic system described remains stable for initial deviations limited within the region of the ellipsoid. E.E.B.

N65-19156# Army Electronics Labs., Fort Monmouth, N. J. Solid State and Frequency Control Div.
U.S. ARMY ADVANCEMENT IN TRANSISTOR RELIABILITY THROUGH MANUFACTURING PROCESS IMPROVEMENTS
E. B. Hakim and B. Reich Nov. 1964 18 p refs
(ECOM-2472; AD-610956)

This report outlines transistor reliability improvements achieved by semiconductor manufacturers who incorporated improving processing techniques into their lines. The procedures reported include the status of reliability of the particular devices used in the program (in most cases the entire family of devices); the methods of monitoring relative improvements; and advanced techniques of specific processes such as diffusion, metalization, lead bonding, packaging, and photoresist. Author

N65-19157# Army Electronics Labs., Fort Monmouth, N. J. Solid State and Frequency Control Div.
ANALYSIS AND DESIGN OF CRYSTAL OSCILLATORS, PART I
Erich Hafner May 1964 55 p refs
(ECOM-2474; AD-611200)

The approach developed in this report appears to satisfy all the major requirements that must be placed on a unifying technique for oscillator analysis and design. The conditions for oscillation in a generally valid form can be processed to determine (1) the amplitude of oscillation in relation to the characteristics of the active device, (2) the requirements on the feedback network to operate the crystal unit according to its specifications, (3) the changes in frequency of oscillation in response to variations in any one of the circuit components and hence the values required for these components to obtain maximum stability, and (4) the output power in proportion to the power dissipated in the crystal unit. A graphical method for solution of the oscillator phase equation in the impedance plane provides impedance diagrams which open the way to a qualitative understanding of the cause–effect relationships in oscillator performance and provide the guidelines for analytic expressions. Detailed discussions are carried out for the Pierce oscillator and the bridged-T oscillator. Author

N65-19169# Army Electronics Labs., Fort Monmouth, N. J. Electron Tubes Div.
GRID-WIRE MOTION IN UHF PLANAR TRIODES
Lawrence E. Scharmann and Helmuth M. Kaunzinger Jan. 1965 13 p ref Presented at the 4th Natl. Conf. on Tube Tech., Sep. 1958
(ECOM-2551; AD-611824)

A study of close-spaced, high-gain, uhf planar triodes revealed that a self-sustained grid-wire motion phenomenon resulted in the generation of unusual audio noise under specific conditions. Analysis of the tube construction and the test circuit indicated that these self-sustained grid-wire oscillations were the result of interaction between the unusually high voltage gradients between plate and grid at normal plate voltages and electrical feedback from the circuitry. Data are presented for tests showing the resultant effects of this phenomenon on a 500-Mc amplifier circuit and an amplitude-modulated, 700-Mc oscillator. Means to avoid the described difficulties or to make practical use of the effect are suggested. Author

N65-19170# Rome Air Development Center, Griffiss AFB, N. Y. Surveillance and Control Div.
FAST HIGH POWER MICROWAVE SWITCHES—A SURVEY
Vincent C. Vannicola Nov. 1964 22 p refs
(RADC-TDR-64-70; AD-609655)

Developments in microwave tube technology are rapidly providing power generating capabilities of increased orders of magnitude. Applications for these power levels find their way into microwave systems associated with long-range high-resolution surveillance, pulse compression, plasma diagnostics, and radiation weaponry. For such applications, it is often necessary to switch the direction of high levels of microwave power in extremely short time intervals. This report discusses most of the switching techniques currently under development which are potentially adaptable for fast switching of high-power microwave signals. Comparisons are made with respect to peak power, switching speeds, losses, isolation, external operating power, degree of complexity, and bandwidth. Author

N65-19175# Microwave Associates, Inc., Burlington, Mass.
APPLICATION OF SEMI-CONDUCTOR DEVICES TO HIGH POWER DUPLEXERS Second Quarterly Report, 1 Jul.–30 Sep. 1964
Paul Basken Griffiss AFB, N.Y., RADC, Jan. 1965 54 p
(Contract AF 30(602)-3278)
(RADC-TR-64-518; AD-611285)

Work performed in the areas of duplexer circuit experimentation and theoretical circuit analysis is described. Findings obtained from tests of TR, ATR, and phase sections are reported. The test results are analyzed, and patterns for future work are established. The theoretical portion covers the power-handling capability of multiple-diode structures, a discussion of treating parasitic reactances in high-frequency diode structures, and a preliminary analysis of the bandpass characteristics of a phase-shaft duplexer. Author

N65-19198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH VACUUM ION SOURCE
M. B. Pyt'yeva, G. V. Spivak, and Ye. M. Dubinina 23 Nov. 1964 9 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 1, 1964 p 142–145
(FTD-TT-64-639/1+2/+4; AD-609138)

A high-vacuum ion source which depends upon the extraction of ion flow from a region of the high density electron beam is described. The basic element of the device is an electron gun with a hollow oxide cathode. The ion characteristics of the device are included. By selection of special conditions, i.e., density of the electron beam, heat capacity of the screen, evacuation rate, evaporation of the electron collector substances, an ion focused electron beam can be obtained under high vacuum of the order of 1×10^{-7} mm Hg. E.E.B.

N65-19206# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN PROPERTIES OF SILICON RECTIFIER VALVES IN PULSED OPERATION
Bohumil Pina 3 Mar. 1965 21 p refs Transl. into ENGLISH from Elektrotechnicky Obzor (Prague), v. 51, no. 12, 1962 p 634–639
(FTD-TT-65-161/1+2; AD-458249)

Static properties of a valve in a forward direction are reported with an insight on temperature dependence and heating. By measuring the volt-ampere, certain characteristics are evaluated, including the magnitude of the thermal coefficient of voltage loss in a forward direction, and the change of its sign and convergence of voltage losses at which the nature of a certain phase is changed to the value given by activation energy. The analysis of the properties of silicon power valves under an impulse load requires not only knowledge of the dependence of volt-ampere characteristics upon temperature, but also an analysis of losses in the valve. Also, measurements carried out on silicon valves, analysis of various types of thermal models, and corresponding measuring results are given. R.W.H.

N65-19247 New Mexico Univ., Albuquerque. Bureau of Engineering Research
THE FABRICATION AND IRRADIATION OF TITANIUM DIOXIDE DIODES
James Woodward and W. W. Grannemann *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 47–70 (See N65-19244 09-24)

Irradiation of titanium dioxide diodes with gamma and X-radiation produced no change in electrical characteristics subsequent to the irradiation. Pulsed gamma radiation of 0.2 μsec duration and an average dose rate of 0.45×10^{-8} erg/cm^2-sec, produced a transient current which was less than the noise level of the test circuitry. Consequently, as a result of this finding, further development for the improvement of the electrical characteristics of titanium dioxide diodes was recommended. Titanium dioxide diodes are much more radiation-resistant than are silicon or germanium diodes. E.E.B.

N65-19250 New Mexico Univ., Albuquerque. Bureau of Engineering Research
ALTERNATING CURRENT BRIDGE METHODS IN TRANSIENT RADIATION EFFECTS STUDIES
L. T. Boatwright *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 157–162 (See N65-19244 09-24)

Qualitative measurements were made on a limited number of components including mica capacitors, resistors, diodes, and miniature transistors, using an X-ray machine capable of delivering a 0.2 microsecond pulse up to 600 kV, a radiation exposure rate of approximately 0.65×10^6 R/sec, and an ac bridge network for measuring change in capacitance. The methods are described; however, results were only qualitative since the equipment had not been calibrated. E.E.B.

N65-19254 New Mexico Univ., Albuquerque. Bureau of Engineering Research
DIRECTIONAL RADIATION STUDY
Goebel Davis and W. W. Grannemann *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 209–212 (See N65-19244 09-24)

Recent interest has developed in orientational effects associated with the transient response of electronic components when exposed to gamma or X-rays. These effects are concerned with the response for omnidirectional versus monodirectional radiation, and the response for different orientations of components relative to the incident radiation. Preliminary, crude calculations using deposited energy as the response criteria indicate that these effects can be a factor of significance. Author

N65-19264*# Thermo Electron Engineering Corp., Waltham, Mass.
CONVERTER PERFORMANCE TEST OF A RHENIUM EMITTER IN CONTACT WITH A CARBIDE FUEL Final Report
R. C. Howard 22 Mar. 1965 40 p
(Contact NAS3-4164)
(NASA-CR-54328; TE-64-65) CFSTI: HC $2.00/MF $0.50

Test devices DC-1 and DC-2 are described, and the test data obtained from their operation is summarized. Demonstrating the feasibility and desirability of rhenium emitters in nuclear heated converters is the main purpose of this test. The

results prove that uranium carbide does not affect the emission from rhenium at temperatures consistent with high power density for at least 200 hours. The consistency of the temperature measurements obtained for DC-1 and DC-2 demonstrated the reliability and reproducibility of the temperature calibration technique employed. The temperature calibration results produced a quantitative measure of the temperature drop penalty at the fuel–emitter interface, inherent in ceramic fuels. Although very high contact pressures were obtained between the fuel and the refractory metal surfaces in contact with it, interface temperature differences of 30° to 60° C were observed even after prolonged soaking. Such severe temperature differences can be avoided using cermet fuels metallurgically bonded to emitter materials. R.W.H.

N65-19288# Army Electronics Labs., Fort Monmouth, N. J. Solid State and Frequency Control Div.
USAEL PRIMARY FREQUENCY STANDARDS
J. G. Zesewitz Jun. 1964 16 p refs
(ECOM-2475; AD-609795)

A primary frequency standard with the utmost in stability and accuracy is required for research into short-term and long-term frequency stability of frequency measuring devices, rf oscillators, piezoelectric crystal-controlled equipments, and also in quartz crystal development. The current standard is a cesium-beam frequency standard with a lifetime stability of 5 parts in 10^{12}. This report gives a brief description of the primary frequency standard, its environmental conditions, the supporting oscillators, and the frequency distribution system. Author

N65-19321# Corning Glass Works, Bradford, Pa. Delay Line Research and Development Dept.
MULTIPLE TAPPED PHOTOELASTIC DELAY LINE Final Report
I. C. Miller 11 Dec. 1964 185 p
(Contract AF 30(602)-2060)
(RADC-TDR-64-434; AD-609579)

This report covers methods of improving the performance of the multiple-tapped photoelastic delay line in the areas of higher frequency operation, wider bandwidth, and increased signal-to-noise ratio. Development of supporting components to provide a practical system capability was also investigated. An experimental model of a 10-megabit matched filter—a practical embodiment of the photoelastic delay line technique—is described. A signal-to-noise ratio of 40 dB was achieved at 15 mc/s by reimaging and concentrating the arc source, however, this is not a practical method for multiple tap systems. Increasing the operating frequency imposes proportionally difficult performance requirements on the optical system; in the 30-mc region, these requirements become impractical, if high signal-to-noise performance must be obtained. At the higher frequencies, it is also much more difficult to obtain wideband transducer drivers. There appear to be many advantages to confining the frequency of operation to the lower (< 30 mc) frequencies; wide bandwidth operation may be more readily obtained by the use of staggered frequency transducers. Author

N65-19356# Mitre Corp., Bedford, Mass.
LEAD ATTACHMENT AND ENCAPSULATION TECHNIQUES FOR THIN FILM MICROCIRCUITS
Patrick N. Everett AFSC, Electron. Systems Div., Feb. 1965 14 p
(Contract AF 19(628)-2390)
(W-6353; ESD-TDR-64-630; AD-611752)

The techniques described were developed for encapsulating experimental thin-film circuits deposited on 0.5-inch square glass substrates. The encapsulation is epoxy, with final package dimensions of 0.6 inch square × 0.125 inch thick. Up to 32 ribbon leads emerge, on 0.050 centers, arranged on the periphery of the package. A factor complicating the encapsulation was the requirement that the leads emerge on the four edges of the unit. A molding process using silicone rubber molds, and a hypodermic filling arrangement was evolved. Author

N65-19367# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
A PRODUCTION ENGINEERING MEASURE FOR THE IMPROVEMENT OF PRODUCTION TECHNIQUES TO INCREASE THE RELIABILITY FOR DIFFUSED SILICON CONTROLLED SWITCHES, TYPES 2N689 Final Engineering Report, 1 Jul. 1963–31 Dec. 1964
J. N. Frank, A. Hishta, R. C. Rome, H. Wawrousek, and W. R. Comstock [1964] 208 p refs
(Contract DA-36-039-AMC-03619(E))
(AD-611565)

A production engineering measure (PEM) for the improvement of production techniques to increase the reliability of a silicon-controlled switch of the 2N689 type is reported. Work was performed on improving the switch subassembly and the device package. The determination of consequences upon the electrical behavior of dislocation–impurity interaction in all-diffused silicon is presented, and the results and summary of the stress tests on the improved device are given. Process operation instructions are included for the improvements. Program conclusions indicate, especially, the realization of the reliability objective. Author

N65-19386# Knights (James) Co., Sandwich, Ill.
HIGH PRECISION 5 MC QUARTZ RESONATORS FOR TEMPERATURE CONTROL BETWEEN 20° AND 30°C
[1964] 48 p
(Contract NObsr-89290)
(Rept.-4; AD-611182)

The design and production of 5-mc, 5th overtone, quartz resonator units to operate on the extremely flat portion of the characteristic AT frequency-temperature curve, between 20° and 30° C is discussed. Data on actual units are compared with calculations; aging data are given. Author

N65-19391# General Electric Co., Syracuse, N. Y. Electronics Lab.
INVESTIGATION OF FERRITE PHASE-SHIFTERS AT C- AND X-BAND Semiannual Report
Robert Seckelmann Dec. 1964 52 p refs
(Contract AF 30(602)-3482; ARPA Order 550)
(SR-1; AD-609813)

Three problems encountered in latched digital phase shifters controlled by partial magnetization, are dealt with. (1) The efficiency of flux transfer and the possibility to add flux bits is discussed. Experimental data and a theory in agreement with these data are presented. (2) The control of rf fields in a ferrite loaded guide to achieve a high differential phase shift per loss, and a linear relation between differential phase shift and transferred flux is also discussed. First results obtained with slab line and waveguide type phase shifters are given. Models to analyze the possible modes in these devices are discussed. (3) The onset of nonlinear losses at a certain magnetic rf-field strength is considered. In a coaxial line completely filled with ferrite a

TEM mode exists. The magnetic field can easily be calculated from the incident power. Threshold field strengths are given for various ferrites. Author

N65-19397# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
SOME NEW TYPES OF FAST AMPLIFIERS [NUOVI MODELLI DI AMPLIFICATORI RAPIDI]
C. Felici 17 Nov. 1964 12 p refs In ITALIAN; ENGLISH summary
(ISS-64/40)

New types of fast amplifiers were modified by improving their characteristics of frequency response. Some transistorized types are presented with gain 8, 24, and 400 and rise time 5, 7, and 12 nsec, respectively. Author

N65-19411# Microwave Electronics Corp., Palo Alto, Calif.
DESIGN AND DEVELOPMENT OF THREE-WATT K_u-BAND TRAVELING-WAVE TUBE Interim Development Report, 1 Jul. 1963–28 Feb. 1964
Mar. 1964 24 p
(Contract NObsr-87501)
(IDR-5; AD-454608)

The package design was completed to include finalizing of the waveguide coupling and the temperature compensation to meet all electrical and environmental specifications. Author

N65-19435# Clevite Corp., Bedford, Ohio. Piezoelectric Div.
PRODUCTION ENGINEERING MEASURE FOR CERAMIC FILTERS Seventh Quarterly Report, 30 Sep.-29 Dec. 1964
A. Lungo [1964] 18 p
(Contract DA-36-039-AMC-01471(E))
(Rept.-7; AD-611413)

A difficulty encountered in the development of the new tumble grinding technique, the solution to this problem, and the evaluation of the grinding rate on 4.3 Mc and 6.0 Mc resonators are discussed. Problems encountered in packaging 1.75 Mc and 4.3 Mc ceramic ladders are described. Also included is a description of a different resonator contact concept which is expected to minimize the assembly problems. Author

N65-19441# Sperry Rand Corp., Gainesville, Fla. Sperry Electronic Tube Div.
SHAPED FIELD HOLLOW BEAM ELECTRON GUNS FOR INTERMEDIATE AND HIGH POWER TRAVELING WAVE TUBES Interim Engineering Report No. 3, 1 Nov. 1964–1 Feb. 1965
Feb. 1965 61 p refs
(Contract AF 33(615)-1501)
(NJ-2761-0173-3; AD-611402)

Continued experiments with the multisegment electron gun were carried on with no anode bias, and with anodes biased linearly and parabolically. Biasing of the anodes produced beams more nearly in accordance with the objectives. It was found that positive flux linkage is very desirable. Electrolytic tank studies which modeled the anode biases showed that a portion of the cathode was subject to a negative electric field and was thus cut off. The computer program for gun analysis is described in detail. Theoretical studies show that positive flux linkage favors rapid turning of electrons toward the exit end of the gun. It is also shown that shaping of the electric field so as to create an electric force toward the exit end of the gun results in a continuous variation in cathode current density, the density decreasing with increasing distance from the exit end of the gun. Author

N65-19443# Utah Univ., Salt Lake City. Microwave Device and Physical Electronics Lab.
[ELECTRON BEAM, QUANTUM AND PLASMA STUDIES] Consolidated Quarterly Report, Jul. 1–Sep. 30, 1964
L. S. Bowman et al 30 Sep. 1964 114 p refs
(Contracts Nonr-1288(05); AF 04(693)-439; AF 33(657)-8677; DA-36-039-AMC-02372-(E); Grant NSF GK-29)
(MDL-Q10; AD-609934)

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N65-19477# Brown Univ., Providence, R. I. Millimeter Wave Lab.
A DIGITAL FERRITE PHASE SHIFTER
D. M. Bolle and G. S. Heller Oct. 1964 25 p Presented at ICMCI, Tokyo, Sep. 1964
(Contracts ARPA E-14; AF 19(628)-2498)
(AD-609495)

A theoretical investigation of the mode structure and the differential phase shift per unit length for the circular cylindrical guide containing a coaxial ferrite tube is presented. It is shown that the maximum differential phase shift occurs for the completely filled guide since the fields show a preference for the isotropic over the anisotropic region. Further, it is noted that when the guide is about two-thirds filled with ferrite ($\tau = 0.36$) the effect introduced by the region of circular polarization near the guide is exactly counterbalanced by the effect felt due to the ferrite approaching the region of circular polarization near the guide axis. Also, calculations to observe the changes in the differential phase shift for a thin tube of ferrite into the guide for values of the tube mean radius are given. E.E.B.

N65-19484# Texas Instruments, Inc., Dallas. Semiconductor-Components Div.
OPTOELECTRONIC FUNCTIONAL ELECTRONIC BLOCKS Interim Engineering Report No. 6, 1 Nov.–31 Dec. 1964
J. R. Biard 2 Feb. 1965 50 p refs
(Contract AF 33(657)-11552)
(TI-03-65-10; AD-610871)

The capabilities of optoelectronic functional electronic blocks are reported. Topics discussed include: (1) a study of the thermal cycling stability of epoxy-clad photo-pairs; (2) the coupling efficiency of photo-pairs using the shaped flat light source; (3) the characteristics of oxide isolated detectors and of FEB-compatible guard-ring structures; (4) gallium arsenide diffusion and dislocation studies, gallium arsenide phosphide technology, and life-test studies of gallium arsenide light sources; and (5) radiative efficiency measurements. Author

N65-19485# Westinghouse Electric Corp., Philadelphia, Pa.
PRODUCTION ENGINEERING MEASURE TYPE 2N2762 SILICON ALLOY TRANSISTOR Quarterly Progress Report, 1 Oct.–31 Dec. 1964

R. J. Pisarcik, J. Priest, and W. E. Shopsky [1964] 21 p
(Contract DA-36-039-AMC-03617(E))
(QPR-6; AD-611217)

Programs for reduction of thickness of collector alloy, and improvement of collector preform annealing were initiated. Process improvements involved base assembly storage, and a reduction in the thickness of the molybdenum mounting disc. A program of step stress testing was also developed as a method of demonstrating improved reliability of the device. Author

N65-19497# Consolidated Systems Corp., Pomona, Calif.
INSTRUMENTATION GROUNDING AND NOISE MINIMIZATION HANDBOOK
Tom L. Gravatt et al Jan. 1965 247 p refs Sponsored by AF
(AFRPL-TR-65-1; AD-612027)

This handbook contains descriptions of grounding techniques for the minimization of noise problems in instrumentation systems, and in power systems where the power system is installed nearby for the purpose of supplying primary power to the data facility. The safety and code requirements are presented, and the causes of noise, noise reduction and prevention, recommended system design practices for data instrumentation facilities, grounding principles for major subsystems of sophisticated data acquisition systems, and good practices for modification, operation, and maintenance of low noise and highly accurate data instrumentation and acquisition systems are discussed. G.G.

N65-19503*# General Electric Co., Schenectady, N. Y. Tube Dept.
DEVELOPMENT OF HIGH TEMPERATURE CERAMIC RECTIFIERS, THYRATRONS, AND VOLTAGE REGULATOR TUBES Final Report, Jun. 26, 1963–Oct. 7, 1964
E. A. Baum 25 Oct. 1963 76 p refs
(Contract NAS3-2548)
(NASA-CR-54303) CFSTI: HC $3.00/MF $0.75

Active alloy enriched nickel–titanium seals, and metallized type seals for vacuum envelopes have operated at 850° C for over 2000 hours. Some of these seals have operated over 3500 hours without failure. Two cathode systems considered for the rectifier and thyratron tubes—the barium and the thoriated cathode—have shown after evaluations, that the barium system has the advantage in efficiency. Also, investigations of the back emission of possible anode and grid materials have shown that pyrolitic impregnated graphite would have minimum emission under actual tube conditions. Based on these results, a high temperature ceramic test diode was designed, fabricated, and operated at 800° C ambient temperature. Further, ceramic voltage regulator tubes were operated up to 800° C in vacuum. Maximum voltage variations of 0.5 volts were found for 10-mA step changes in current with stabilization times of 5 to 10 minutes. E.E.B.

N65-19519# Army Electronics Labs., Fort Monmouth, N. J.
RESEARCH ON HETEROJUNCTIONS (GROWTH OF GALLIUM PHOSPHIDE SILICON HETEROJUNCTIONS), PART I
James S. Kesperis, Robert S. Yatsko, and Phillip A. Newman Jun. 1964 39 p refs
(ECOM-247; AD-611039)

This report is a summary of experimental progress in continuing research with new semiconductor materials and devices. Specifically described is the investigation of epitaxial techniques for the growth of gallium phosphide on silicon. Open-tube vapor phase transport methods using the reaction of gallium oxide with red phosphorus yield large amounts of vapor-grown GaP, but are found incapable of producing epitaxial layers on silicon. Similar techniques using PCl_3 and metallic gallium as the reactants have yielded GaP overgrowths on silicon shown by X-ray diffraction to be single crystal. Heterojunctions of GaP on 5-ohm cm P-type exhibit photovoltages of 0.17 volts and barrier heights by capacitance measurement of 0.03 volts. Author

N65-19526# Technische Hochschule Munchen (West Germany). Inst. für Hochfrequenztechnik
RESEARCH ON ANTENNAS. I: ROD ANTENNA WITH TUNNEL DIODE. II: SCIMITAR ANTENNAS Annual Summary Report, 1 Sep. 1963–30 Sep. 1964
H. H. Meinke [1964] 148 p refs
(Contract AF 61(052)-506)
(ASR-3; AD-610578)

A rod is cut in two parts and joined again by a complex impedance. This impedance is produced by a tunnel diode, shunted by a short circuited line of variable length. Current distribution and input impedance are calculated and measured. Amplification factor and mutual coupling between two parallel antennas are treated theoretically. A method for measuring the mutual coupling is developed. For better understanding of the radiation diagram, the electrical and magnetical near field and the current distribution on the scimitar are measured. To improve the broadband matching of the input impedance and the radiation diagrams new forms of scimitars were tested (radiation diagram, input impedance, near field and current distribution). Author

N65-19529# Radio Corp. of America, Lancaster, Pa. Direct Energy Conversion Dept.
RESEARCH STUDIES ON THERMIONIC CONVERTERS, EMITTER SHELL PHASE Fourth Quarterly Technical Report, 1 Apr.–15 Dec. 1964
G. Y. Eastman Dec. 1964 43 p refs
(Contract DA-36-039-AMC-03197(E))
(Rept.-4; AD-611403)

Of 18 converters fabricated, 16 were with the double-walled emitter-shell geometry. After the solution of a number of fabrication problems, a converter was constructed which produced power output equivalent to electrically heated converters. This converter was successfully life tested for 1000 hours at an average emitter temperature of 1235° C. A second converter was life tested at an emitter temperature of 1320° C for 202 hours before failing. A converter was subjected to thermal cycling from −40° to +1400° C in less than 5 minutes without failure. Permeation testing was carried out on an aluminum oxide sample in a fossil-fuel environment. The principle permeating gas was shown to be oxygen. Author

N65-19536# Autonetics, Anaheim, Calif. Electro Sensor Systems Div.
DEVELOPMENT OF A THIN FILM MICROCIRCUIT FACILITY
Frank B. Iles 11 May 1964 12 p refs Reprinted 27 Jul. 1964

The development of a microcircuit production facility based on a feasibility program is outlined. The research feasibility study is expanded into a 1000 piece per month prototype production facility with all time study and process development charts included. Production capability of this prototype factory can be expanded into any required output by using the application multiple included in the process development chart. Author

N65-19550 Collins Radio Co., Newport Beach, Calif.
FILTER CRYSTAL DEVELOPMENT PROGRAM (70 TO 150 MC) Quarterly Progress Report, 15 Jul.–15 Oct. 1964
R. A. Auriemma and W. D. Peterson 5 Mar. 1965 23 p
(Contract DA 36-039-AMC-03207(E))
(QPR-5; AD-458536)

The experimental work concerned with the 70-Mc group of crystals was completed. This report discusses the results of this study. Emphasis is placed upon the problem areas encountered in this study—the erratic behavior of the motional resistance of the crystal units and the problems encountered in trying to accurately measure the resonant frequency of unplated crystal blanks. The methods and equipments being used to resolve these difficulties in the 90-Mc study are discussed in detail. Author

N65-19563# Radio Corp. of America, Somerville, N. J. Semiconductor and Materials Div.
DEVELOPMENT OF A UHF POWER TRANSISTOR Quarterly Report, Jul. 1–Sep. 30, 1964
E. F. Breniak [1964] 8 p
(Contract DA-49-168-AMC-118D)
(QR-1; AD-609626)

Effort was directed primarily towards cost reduction. Improved operator training and continued refinement of process techniques, such as improved phosphorus deposition and increased oxide thickness over the base area, improved dice test yields by approximately 30%. Improvements were also made to enable the device to withstand high stress under a wide range of mechanical and environmental conditions. Lower mass and stronger bonds make aluminum more resistant to high centrifuge and shock. Results of shock testing are included. E.E.B.

N65-19583# Michigan Univ., Ann Arbor. Electron Physics Lab.
BASIC RESEARCH IN MICROWAVE DEVICES AND QUANTUM ELECTRONICS Quarterly Progress Report, Aug. 1–Nov. 1, 1964
H. K. Detweiler, M. E. El-Shandwily, B. Ho, J. E. Rowe, and C. Yeh Nov. 1964 50 p
(Contract NObsr-89274)
(QPR-6; AD-453343)

Equations for the modulation products in the multisignal analysis of an amplitude- and phase-modulated traveling-wave amplifier were programed and the results computed. The computation includes the nonlinear approach using the two-signal input, the large-signal analysis using the multiple signal input and the Boltzmann transport equation approach using the multiple signal input. The output powers of some important cross-modulation components are presented in graphs. Experimental results using two and three signal inputs are presented for comparison. A large-signal analysis is carried out for a dc-pumped quadrupole amplifier employing cyclotron-synchronous wave interaction. Criteria for the validity of small- and large-signal analyses are established by the phase slip. Energy relations between the beam and the pumping field are discussed for a strong pumping field condition that would lead to the anomalous gain possibility. The technique for insertion of the helix–BeO rod into a metal envelope to improve the thermal conductivity of the assembly is developed. Author

N65-19586# Radio Corp. of America, Harrison, N. J. Microwave Tube Operations Dept.
A 10-Mw, X-BAND TUNNEL-DIODE OSCILLATOR Final Report, 1 Jul. 1963–31 Aug. 1964
E. Diamond, E. Casterline, R. Gold, and D. Nelson [1964] 68 p refs
(Contract DA-36-039-AMC-03195(E))
(AD-458145)

Tunnel-diode oscillators were developed for X-band. Each oscillator contained a single diode in a low inductance package, and delivered between 2 and 2 1/2 milliwatts of rf power. Three and one half milliwatts were obtained in initial experiments with two oscillators operating in parallel. It appears that power outputs up to 5 mW are possible with this technique. Diode technology was improved to the point where speed ratios of up to 100:1 were obtained with corresponding cutoff frequencies up to 30 Gc. A theoretical analysis was developed which allows determination of the power that may be expected from a tunnel diode with given characteristics. The validity of the theory was established by comparison with experimental results. Author

N65-19588# Thermo Electron Engineering Corp., Waltham, Mass. Research Dept.
THERMIONIC EMITTER MATERIALS RESEARCH PROGRAM Second Annual Technical Summary Report, 1 Jul. 1962–30 Sep. 1963
S. S. Kitrilakis and J. H. Weinstein [1963] 115 p refs
(Contract Nonr-3563(00))
(Rept.-27-64; AD-425895)

The performance, over a wide range of parameters, of rhenium and iridium as thermionic emitter materials opposite molybdenum collectors, is reported. A study of molybdenum-collector work function opposite three different emitter materials is reported, and a correlation against collector-to-reservoir temperature ratio is shown to exist. Emitter work functions are reported, and a correlation against emitter-to-reservoir temperature ratio is demonstrated and shown to correspond to Rasor's theoretical predictions. A correlation between converter internal voltage loss and the product of cesium pressure and interelectrode spacing is demonstrated, and the relationship between this factor and the optimum performance maps derived. The usefulness of the data and correlations to the theoretician and the hardware designer is delineated. Author

N65-19615# Radio Corp. of America, Camden, N. J. Communications Systems Div.
MICROELEMENT DIODES, PRODUCTION ENGINEERING MEASURE Formal Engineering Report
Nov. 1964 151 p
(Contract DA-36-039-SC-75968)
(AD-608775)

CONTENTS:

1. GENERAL PURPOSE SILICON DIODE MICROELEMENT 32 p (See N65-19616 09-09)
2. GENERAL PURPOSE SILICON DIODE MICROELEMENT 27 p (See N65-19617 09-09)
3. SILICON ALLOY VOLTAGE REGULATOR DIODE AND SILICON GENERAL PURPOSE DIODE MICROELEMENTS 31 p (See N65-19618 09-09)
4. DIODE MOUNTING 55 p (See N65-19619 09-09)

N65-19616 Fairchild Semiconductor Corp., San Rafael, Calif.
GENERAL PURPOSE SILICON DIODE MICROELEMENT Final Report
In RCA Microelement Diodes, Production Eng. Measure Nov. 1964 32 p (See N65-19615 09-09)

The diode uses a packaging concept which takes a standard die and encapsulates it in a high-thermal-conductivity, rugged package. The original purpose of the design was to make a device which would withstand the severe environmental and mechanical ruggedness requirements of the military systems. Therefore, the diode was designed with a minimum of parts to eliminate the possibility of failure of the many components of other types of packages. The success of this package is clearly demonstrated. Author

N65-19617 Microsemiconductor Corp., Culver City, Calif.
GENERAL PURPOSE SILICON DIODE MICROELEMENT Final Report
In RCA Microelement Diodes, Production Eng. Measure Nov. 1964 27 p (See N65-19615 09-09)

The devices featured a passivated silicon microdiode, designed to remove the surface failure mechanisms common to conventional diode types. This miniature diode met all of the environmental requirements, but mechanical failures required redesign of the diode mounting technique. Author

N65-19618 Hughes Aircraft Co., Newport Beach, Calif. Hughes Components Div.
SILICON ALLOY VOLTAGE REGULATOR DIODE AND SILICON GENERAL PURPOSE DIODE MICROELEMENTS Final Report
In RCA Microelement Diodes, Production Eng. Measure Nov. 1964 31 p (See N65-19615 09-09)

The technique of solder mounting was selected, and the hermeticity of the package was measured and found to be compatible with module processing procedures. Using this selected technique, 200 devices were generated, and life tests were sucessfully completed although problems with an acid solder mounting flux were encountered. Another 300 devices were generated using this technique with slight modifications (higher melting point solders). Difficulty was encountered due to catastrophic electrical losses resulting when out-of-specification solder was used, and alternate mounting technique was chosen using axial-leaded components. The mounting of axial-leaded parts has proven to be faster and more reliable than the solder mounting of micro pills. Author

N65-19619 Radio Corp. of America, Somerville, N. J. Electronic Components and Devices Div.
DIODE MOUNTING Final Report
In RCA, Camden, N.J. Microelement Diodes, Production Eng. Measure Nov. 1964 55 p (See N65-19615 09-09)

The feasibility of mounting diodes was demonstrated with a tweezer-type welder, but later investigations led to the development of a gap-welding technique, which offered significant advantages. One important operating advantage is the ability to readily observe the welding action under magnification, which was of great help in establishing the desired welding parameters. Many types and thicknesses of diode lead materials were evaluated to determine their weldability. The best lead materials, in order of preference, are platinum, palladium, nickel, kovar, rodar, dumet, and silver. Gold plating of these conductor materials (except platinum and silver) was found to improve results. Author

N65-19631# Microwave Associates, Inc., Burlington, Mass.
SOLID-STATE GENERATOR Quarterly Progress Report, 1 Sep.–30 Nov. 1964
Ernst F. Scherer [1964] 20 p refs
(Contract NObsr-89356)
(QPR-6; AD-609675)

The oscillator-buffer stage was modified by increasing capacity and inductance of the tuning elements. Also, the tuning characteristics of the voltege control oscillator were improved by decreasing the required voltage variation over the tuning range. The power output was increased by approximately 5 dB. Preliminary measurements also showed an improvement in stability from 0.125 Mc/°C to 0.30 Mc/°C for the uncompensated oscillator. The power capability of the multiplier stage was improved by increasing the capacity of the varactor and by lowering the bias regulator. The best results were obtained with a diode capacity in the range of 20 pf at zero volts and a breakdown voltage of 140 volts. Each individual stage of the rf signal generator was tested and tuned into a load and source impedance of 50 ohms in order to simplify the interconnection between stages. E.E.B.

N65-19632# Montek Div., Model Engineering and Mfg. Corp., Salt Lake City, Utah.
SOLID STATE TACAN Final Report, Jul. 15, 1963–Jan. 31, 1964
Thiel J. Gomm, R. Max Steadman, Harold C. Renner, and K. Charles Eder Bedford, Mass., AFSC, Electron. Systems Div., Sep. 1964 232 p
(Contract AF 19(628)-3263)
(ESD-TDR-64-548; AD-609810)

The objectives of this program were to perform the necessary design, development, and fabrication of circuitry required for integrating the major solid-state components and subsystems provided by various vendors into an experimental solid-state TACAN transponder beacon and monitor, and to evaluate these components as subsystems and as a complete TACAN transponder system with monitor. A four-man team accomplished the following: (1) resolved the problems found in the major solid-state components (subsystems) previously procured; (2) solved the interface problems between the solid-state components; (3) integrated the major components into a solid-state TACAN ground transponder beacon with monitor; (4) maintained and utilized an airborne interrogator–responder to assist in the testing of the solid-state transponder breadboards. Author

N65-19647# Pisa Univ. (Italy). Centro Studi Calcolatrici Elettroniche del C.N.R.
HIGH SPEED TECHNIQUES OF SWITCHING AND LOGICAL ORGANIZATION [TECNICHE VELOCI DI COMMUTAZIONE E ORGANIZZAZIONE LOGICA]
F. Denoth, G. B. Gerace, P. Maestrini, and B. Pellegrini Brussels, EURATOM, Oct. 1964 225 p refs In ITALIAN; ENGLISH summary
(Contract EURATOM-027-61-12 CETI)
(EUR-2112.I) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 290 Belg. Fr.

This report deals with the analysis and the design of various high-speed switching circuits and the organization of logical systems. The analysis of both nonsaturating and saturating diode-transistor circuits is given. Three building block structures are designed: current switching mode, antisaturating mode and saturating three-level logic mode. Experimental results are reported in detail. A graphical method is presented for analyzing switching transients in tunnel diode circuits. Tunnel diode nonsynchronous switching circuits are also investigated. Problems concerning the organization of both synchronous and asynchronous systems are treated. A new model for pulse mode sequential circuits is also presented. Author

N65-19724# Army Engineer Research and Development Labs., Fort Belvoir, Va.
FATIGUE OF ANTIMONY-CESIUM PHOTOCATHODES
N. S. Khlebnikov and P. A. Sinitsyn [1964] 10 p ref Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 10, no. 22, 1940 p 1913–1918
(AD-606164)

The article describes experiments showing that antimony–cesium vacuum photocathodes display, in addition to high integral sensitivity, extremely low fatigue under the conditions characteristic of prolonged operation (for example, in sound films); the variations in spectral response occurring as a result of fatiguing are described, and a new parameter is proposed permitting comparison of phototubes with respect to fatigue. Author

N65-19725# Pennsylvania Univ., Philadelphia. The Moore School of Electrical Engineering
STUDIES OF ELECTROMAGNETIC COMPATIBILITY OF EQUIPMENT AND SYSTEMS Progress Report No. 15, 1 May–31 Jul. 1964
R. M. Showers, S. C. Moorthy, M. Massaro, A. Weinrach, H. L. Logan et al 31 Aug. 1964 20 p ref
(Contract NObsr-85170)
(Rept.-65-04; AD-454588)

A data review on cable and equipment susceptibility led to the development of two quantitative models for hull penetrations. Phase reversal tests on three different cable types found a two-wire line model sufficient to represent the external field of a coaxial cable. Shielding characteristics of a coaxial cable with a copper inner conductor were superior to other cables at frequencies above 5 kc/sec. Comparative studies of the shielding effectiveness of a plain sheet of steel, and a steel plate with a long slit established that the plain sheet ceases to be an effective shield if it has a very small airgap. Both the Cu–Fe electrodes and stainless steel electrodes were used with the NaCl electrolyte. They exhibited a noise data spectrum which was independent of the electrode current after the initial oxidation period, and which increased in amplitude with higher temperatures. The velocity-induced noise for a static magnetic field of 2300 gauss was measured and found proportional to velocity, and inversely proportional to frequency. Compensating networks using the radiating dipole model of the submarine as a noise source were used to establish the correlation between several sensor combinations. G.G.

N65-19742# Bernard Electronics Co., Washington, D. C.
WIRELESS CONTROL SYSTEM FOR AIRPORT LIGHTING Final Report
Arthur H. Ballard Jan. 1965 70 p refs
(Contract FA-WA-4632)
(RD-65-8)

An experimental system for wireless control and monitoring of airport lighting was developed with the objective of providing a cheaper, more flexible and reliable system than existing cable systems. The system provides a 16-channel capacity on a single FM carrier with a maximum range of 3 miles. Three channels (selectable) provide on-off, and 5-step continuous control in the form of 0- to 10-volt dc commands. Remote stations reply automatically with identical signals to actuate displays at the master station. Electrical comparisons of signals indicate incorrect reply or failure in any channel. Failsafe provisions at each remote station switch the lighting equipment to full on, full off, or the last commanded brightness, in the event of system failure. When engineered for quantity production, system cost is estimated to be approximately $2000 per 2-way channel, including RF equipment. Author

N65-19758*# Lockheed-Georgia Co., Marietta. Georgia Nuclear Labs.
COMPONENTS IRRADIATION TEST NO. 8 2N918 TRANSISTORS IN250 DIODES TANTALUM CAPACITORS
30 Oct. 1964 69 p
(Contract NAS8-5332)
(NASA-CR-57352; ER-7686) CFSTI: HC $3.00/MF $0.75

Transistors, and diodes were subjected to nuclear radiation at a controlled temperature of 46° C. Capacitors were irradiated in a vacuum environment at ambient temperature. Both capacitance and leakage of the capacitors were increased by irradiation. However, both increases appeared to be primarily radiation rate phenomena with no significant permanent change from pretest values. Author

N65-19788# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ADVANCED MOLECULAR SYSTEMS TECHNOLOGY. VOLUME II: DEVELOPMENT PROCEDURES
Dec. 1964 98 p refs
(Rept.-19098)

Procedures were developed for molecularizing systems in near entirety, rather than on a piecemeal basis, using commercially available molecular electronic devices wherever possible. A family of general purpose devices and a breadboard technique for rapid circuit design were developed. Special compatible circuit techniques for functional augmentation were combined with compatible micropackaging methods. Quick response capability was achieved by a careful analysis of all process operations in order to predict and control the mechanisms which govern yield and potential device reliability. E.P.V.

N65-19887*# Microwave Electronics Corp., Palo Alto, Calif.
DEVELOPMENT OF A LOW-NOISE, COLD-CATHODE TRAVELING-WAVE TUBE Monthly Progress Report No. 3, 31 Oct.–30 Nov. 1964
Dec. 1964 4 p
(Contract NAS5-9002)
(NASA-CR-57502) CFSTI: HC $1.00/MF $0.50

Two metal–ceramic diodes were fabricated. A fabricated gun for cold cathode operation is described. The gun is made with two cathode support structures. Between them are electrodes which will collect emitted electrons from the cold cathode. One structure is for the cold cathode; the other for the barium oxide source. Detailed description is provided. E.E.B.

N65-19891*# General Electric Co., Syracuse, N. Y. Semiconductor Products Dept.
RESEARCH TO DETERMINE FAILURE MODES FOR TRANSISTORS Third Quarterly Report, Apr.–Jun. 1964
Robert G. Quick [1964] 165 p
(Contract NAS8-11059)
(NASA-CR-57457)

Of the defective units, 79% could have been eliminated by a screen which eliminated only 18% of the good units. This showed an improvement from 45% bad units in the lot before screening to 16% after screening. To accomplish this improvement it was necessary to screen to I_{CBO}, $h_{FE(max)}$, $V_{BE(SAT)}$, I_N at 100 cycles and I_N at 100 kc. In this study I_{CBO}, $V_{BE(SAT)}$, and the two noise currents had the largest errors. A simple change is possible in the measurement of $V_{BE(SAT)}$ or noise current which will improve the accuracy of the effectiveness in selecting transistors. Some initial ideas are proposed to develop selective sampling to replace the

process; (2) to the analytical analysis of the amplitude effects; (3) to the definition of the interference-to-signal ratio in terms of the parameters of the process; and (4) to the definition of frequency classes useful in the generation of interference free assignments. An example of the reduction of the theoretical chart to the practical on the basis of the theory and test data is given. The general application of the theory to such reduction and to frequency assignment, however, is hampered at present by the lack of systematic and complete experimental data. The test parameters, conditions, and procedures which theory indicates as necessary for obtaining meaningful experimental data are outlined. Author

N65-20104*# Recon, Inc., Tallahassee, Fla.
STUDY TO ESTABLISH TRANSIENT SUPPRESSION TECHNIQUES AND CRITERIA. PHASE I REPORT: LITERATURE SEARCH
Harvel N. Dawirs, Thomas M. Fisher, and Donald M. Palmer 30 Sep. 1964 37 p refs
(Contract NAS8-11362)
(NASA-CR-5719; RECON-TR-17) CFSTI: HC $2.00/MF $0.50

The literature study for establishing methods of minimizing electrical interference from switching inductive circuits is reported. A bibliography of articles reviewed and a summary of the pertinent material are included. Author

N65-20105*# Hughes Aircraft Co., Culver City, Calif.
THE STUDY OF MULTIPACTOR BREAKDOWN IN SPACE ELECTRONIC SYSTEMS Third Status Report, Dec. 1964
27 Jan. 1965 13 p
(Contract NAS5-3916)
(NASA-CR-57520) CFSTI: HC $1.00/MF $0.50

Measurements of harmonic content of the electron current in a typical discharge are reported. A typical collector current waveform is included. By graphical Fourier analysis, the following expression was found for the collector voltage: $E_{collector} = 666\sin(\omega t - 12°) + 240\sin(2\omega t + 77°) + 73\sin(3\omega t + 167°)$mV. At the time these measurements were taken, the voltage between the discharge plates was about 105 V rms, and the power dissipation was about 3 W. Since the total fundamental electron current was 0.34 A, the electron current must have been at a phase of 85° with respect to the electrode voltage, and should have caused severe detuning to the rf structure. This was not observed and the anomaly has not as yet been explained. Results are also reported for a number of noise generation tests. E.E.B.

N65-20119# Westinghouse Electric Corp., Washington, D. C.
HIGH CURRENT AND HIGH VOLTAGE SILICON CONTROLLED RECTIFIERS Final Development Report, 29 Jun. 1962–31 Oct. 1964
T. C. New, T. P. Nowalk, A. N. Knopp, W. C. Fry, H. E. Ferree et al [1964] 154 p refs
(Contract NObsr-87647)
(AD-608823)

The basic device and encapsulation designs for the 500-V/500-A switch are given, and the device fabrication process is outlined. The problems with silicon material for such a large area device are treated in detail. Equivalent emphasis is given to device characterization since the 500-A current level—with all of its implications—is far in excess of commercially available silicon controlled rectifiers. Data are reported on 50 final device samples. These devices are the largest silicon controlled rectifiers ever fabricated and represent a tremendous advance in the state-of-art of semiconductor power switches. Author

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N65-18654# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF THE CHARACTERISTICS OF A PARAMETRIC AMPLIFIER USING FUNDAMENTAL OR SUBHARMONIC PUMPING
Kuang-ming Shen, T'yen-ming Kao, and Ch'ing-hual Mao 28 Jan. 1965 28 p refs Transl. into ENGLISH from Wu Li Hsueh Pao (Peking), v. 19, no. 6, 1963 p 384–397
(FTD-TT-64-769/1+2+3+4; AD-610647)

The results of this analysis are threefold: (1) Expressions for the principal characteristics, such as figure of merit, power gain, and bandwidth, were derived for parametric amplifiers using fundamental or subharmonic pumping, and a comparison between these amplifiers was made in terms of the characteristics derived. (2) Quantitative relations between the amplifier characteristics and the pumping voltage and bias were determined by the method of analyzing harmonic components for the nonlinear capacitance of a semiconductor diode, and the stability requirement concerning the amplitude and frequency of pumping was established under the conditions of specified amplifier characteristics. (3) The effective noise figure of these amplifiers was derived, and the conditions to minimize the effective noise figure in a design are discussed. Factors such as the diode losses, signal-to-idler bandwidth ratio, match, etc., were taken into consideration. A numerical example was given to illustrate the use of our results as a possible design procedure for the parametric amplifiers. Author

N65-18696# Norwegian Defence Research Establishment, Kjeller.
RESEARCH ON THE THEORY AND DESIGN OF ACTIVE NETWORKS Annual Summary Report No. 3, 1 Jul. 1963–30 Jun. 1964
Kjell Blotekjaer and Tor Schaug-Pettersen 23 Jul. 1964 36 p refs
(Contract AF 61(052)-484)
(E-36; AFCRL-64-823; AD-609434)

The report is concerned with studies in microwave ultrasonics and acoustic wave propagation in piezoelectric semiconductors. Saturation due to acoustic oscillations in cadmium sulfide was observed experimentally, and the drift mobility of electrons in the sample was determined to 210 cm^2/V at room temperature. A nonlinear coupling between acoustic waves and electromagnetic waves in piezoelectric materials is described, and an experiment for parametric excitation of subharmonics is outlined. The thermal noise due to free carriers in electroacoustic amplifiers is calculated. The equivalent noise temperature can be made considerably lower than the temperature of the amplifying crystal. A novel design of an efficient piezoelectric transducer for hypersonic waves is described. The coupler comprises a number of piezoelectric discs in a specific arrangement located in the gap of a reentrant microwave cavity. Author

N65-18754 Joint Publications Research Service, Washington, D. C.
SEARCH FOR ERRORS AS ABSORPTION MARKOV CHAINS

L. A. Pchelintsev *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 31–36 refs (See N65-18751 09-34) CFSTI: $6.00

A method is proposed for searching for an optimal strategy for finding a faulty element in a radio electronic system in the presence of a priori distribution of probabilities of breakdown of the element. The essence of the method consists in investigation of the search process as a Markov process. The practical application of the procedure is illustrated by a numerical example. Author

N65-18766 Joint Publications Research Service, Washington, D. C.

ON INVESTIGATION OF NON-LINEAR AUTOMATIC SYSTEMS BY THE METHOD OF CROSS-SECTION OF SPACE OF THE PARAMETERS

R. A. Nelepin *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 175–187 refs (See N65-18751 09-34) CFSTI: $6.00

A new approach is proposed for investigation, by analytical exact means, of nonlinear automatic systems based on the study of specially selected cross sections of the space of the parameters. The proposed method permits reduction of investigation of dynamics of a nonlinear system of the nth order under conditions of the investigated cross sections of the space of the parameters to investigation of a number of systems of the first and second orders with the same nonlinearities. Author

N65-18767 Joint Publications Research Service, Washington, D. C.

SENSITIVITY AND DYNAMIC ACCURACY OF CONTROL SYSTEMS

M. L. Bykhovskiy *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 188–207 refs (See N65-18751 09-34) CFSTI: $6.00

A mathematical apparatus is proposed along with technical procedures for solution of the problem of behavior of a system when changing its parameters. For evaluation of sensitivity, coefficients of influence are introduced and operators are defined. Application of the proposed apparatus to the problem of dynamic accuracy, problems of control, and construction of learning models is discussed. Author

N65-18768 Joint Publications Research Service, Washington, D. C.

SYNTHESIS OF LINEAR AUTOMATIC SYSTEMS WITH RESPECT TO THE MINIMUM OF MEAN SQUARE ERROR TAKING INTO ACCOUNT AN INVARIANT PART OF THE SYSTEM

O. B. Kleshko *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 208–221 refs (See N65-18751 09-34) CFSTI: $6.00

A method is proposed for determination of the optimal transfer function of a linear automatic system at the input of which arise a useful signal and noise which are represented by fixed random functions of time. The optimal transfer function is determined beginning from the criterion of minimum least square error under the condition that the power of the denominator of the transfer function of the correction circuit does not exceed the power of the numerator of this function. Author

N65-18769 Joint Publications Research Service, Washington, D. C.

ON THE USE OF SIGNALS WITH RESPECT TO DISTURBANCE EFFECTS IN RAPID ACTION AUTOMATIC SYSTEMS

A. N. Voronin *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 221a–226 refs (See N65-18751 09-34) CFSTI: $6.00

The influence of basic excitation effects on optimal transfer processes in rapid action automatic systems is investigated. Introduction of relationships is proposed for optimizing the system in the variation of these disturbance effects. Author

N65-18770 Joint Publications Research Service, Washington, D. C.

ON STABILITY OF A CLASS OF AUTOMATIC CONTROL SYSTEMS WITH VARIABLE PARAMETERS

M. A. Bermant and S. V. Yemel'yanov *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 227–236 refs (See N65-18751 09-34) CFSTI: $6.00

The problem of stability of automatic control systems with variable structure is investigated for systems using stabilization of linear objects with parameters which vary quite rapidly within wide limits. Sufficient conditions are found for stability; it is shown that if the system is stable for any fixed values of the coefficients lying in the given limits, then it is stable also for any type of variation of coefficients within the limits. Author

N65-18772 Joint Publications Research Service, Washington, D. C.

ON THE PROBLEM OF STABILIZATION OF CONTROL SYSTEMS

Ye. A. Gal'Perin *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 246–251 refs (See N65-18751 09-34) CFSTI: $6.00

In the development on investigations, a procedure is discussed which simultaneously solves the problem of existence and of construction of a linear regulator which stabilizes steady-state motion of a control system with respect to the first approximation. Author

N65-18773 Joint Publications Research Service, Washington, D. C.

STABILITY OF FORCE GYROSTABILIZORS FOR A HIGH VALUE OF THE AMPLIFICATION COEFFICIENT

N. T. Kuzovkov *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 252–262 refs (See N65-18751 09-34) CFSTI: $6.00

Dimensions of the region of stability, and damping speed of the free oscillations of a single axis force gyrostabilizor are compared for differentiating and integrating correction circuits. A new procedure is indicated for constructing varying parameters for a system of signs of equal values with respect to the coefficient of damping the oscillatory components of the transient process. Author

N65-18887 Library of Congress, Washington, D. C. Aerospace Technology Div.

SOVIET RESEARCH ON MICROWAVE POWER GENERATION, II. OPTIMALIZATION OF THE PERFORMANCE OF PLANOTRONS AND NIGOTRONS

Arsen Iwanovsky *In its* Foreign Sci. Bull. Feb. 1965 p 20–28 refs (See N65-18884 09-34)

An analysis of Soviet research on microwave power generation considers the problems involved in optimalizing planotron and nigotron performance. From the beginning of the planotron–nigotron project, the designers paid particular attention to factors which negatively influence the efficiency of these systems. An analytical treatment of anode and cathode losses is presented, followed by an analysis of the optimum trajectories of electron motion in the working space, together with the emitter-cathode geometry considered favorable for obtaining maximum efficiency. Author

N65-18888 Library of Congress, Washington, D. C. Aerospace Technology Div.
THE DEPENDENCE OF OPTIMAL CONTROL ON THE PARAMETERS OF THE CONTROLLED PROCESS
Leonas Kacinskas *In its* Foreign Sci. Bull. Feb. 1965 p 29–32 refs (See N65-18884 09-34)

With the assumption that controlled-process parameters (order of the transfer function, distribution of its zeros and poles, location of the points of application of control signals, etc.) can be varied, the dependence of the dynamic accuracy of the control on these parameters is analyzed. A method based on the results of M. G. Kreyn's L-problem is used for the solution of this problem. The results derived can be used in designing an optimal process and optimal controller. Author

N65-19019# Illinois Univ., Urbana. Antenna Lab.
ON ANALYTIC CONTINUATION OF A CLOSED REGION SOLUTION TO AN OPEN REGION Technical Report No. 2
R. Mittra and D. S. Karjala Nov. 1964 18 p refs
(Contract AF 19(628)-3819)
(AFCRL-64-952; AD-609857)

The purpose is to investigate if it is possible to derive the solution of an open region problem as a limiting case of a closed region boundary value problem. The particular geometry is that of a bifurcated waveguide which becomes equivalent to a semi-infinite parallel plate waveguide when the top plate coefficient in the parallel plane bifurcated waveguide may be analytically continued to yield the reflection coefficient in the semi-infinite waveguide radiating into space. The latter problem was solved by Vainshtein, Marcuvitz, and Noble. The technique described may prove useful for solving other open region problems such as the launching of surface waves by a semi-infinite waveguide for which the application of Wiener–Hopf technique is fairly involved. Author

N65-19136# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROCEEDINGS OF THE MACHINE-CONTROL INSTITUTE Selected Articles
23 Nov. 1964 29 p refs Transl. into ENGLISH from Tr. Inst. Mashinoved. (USSR), no. 17, 1963 p 3–11, 89–97
(FTD-TT-64-412/1+2+4; AD-609142)

CONTENTS:

1. STABILITY IN SELF-BALANCING BRIDGES V. V. Anokhina and V. I. Sergeyev p 1–13 refs (See N65-19137 09-09)

2. OPTIMIZATION OF ONE SCHEME FOR DETECTING FAULTS Yu. V. Lyubatov p 14–26 refs (See N65-19138 09-10)

N65-19138 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OPTIMIZATION OF ONE SCHEME FOR DETECTING FAULTS
Yu. V. Lyubatov *In its* Proc. of the Machine-Control Inst. 23 Nov. 1964 p 14–26 refs (See N65-19136 09-10)

As equipment systems become increasingly more complex the problems of testing and detecting faults take on great significance. The possibility of reducing testing time through rational organization of test procedures using probability considerations was studied. Also, the average time required for localizing the faulty block was investigated. A general solution to the problem which allows for the possibility of failure in several blocks is given. A mathematical model is described and equations for the optimum strategy in the detection of faulty blocks are derived. E.E.B.

N65-19302# Illinois Univ., Urbana. Coordinated Science Lab.
STATE MODELS OF ACTIVE RLC NETWORKS
Ahmet Dervisoglu Dec. 1964 14 p refs
(Contract DA-28-043-AMC-00073(E))
(R-237; AD-609700)

A necessary and sufficient condition for the existence of the state model of active RLC networks with mutual inductances is presented. This is also a necessary and sufficient condition for a unique solution of the network. Also, a systematic procedure for deriving the state model, which may be carried out by a computer, is given. Further, in active RLC networks in which dependent sources are controlled by passive elements, the existence of a tree which contains all voltage sources as branches and all current sources as chords is only a necessary condition for a unique solution. Unlike the passive case, the order of state vector depends not only on the topology of the network but also on the controlling coefficients of the dependent sources in the network. E.E.B.

N65-19448# New York Univ., N. Y. Lab. for Electroscience Research
ON THE REALIZATION OF BINARY SWITCHING FUNCTIONS WITH MAJORITY GATES Technical Report No. 400-100
Manush Raship 30 Sep. 1964 38 p refs
(Grant AF-AFOSR-24-64)
(AFOSR-64-2495; AD-609504)

For switching circuit design with majority gates, an augmented function is derived that permits the residue test to determine which of the constants, as well as which of the literals of a binary switching function, must appear as inputs in a realization. A synthesis procedure employing this approach is presented that yields an upper bound on the number of stages required. A table is derived of all switching functions which may be realized with a network composed of two stages of three-input majority gates. A single function type obtained from the table demonstrates, however, that an optimal realization (defined as that network having the fewest gates of those having the smallest number of stages) with one type of majority gate cannot always be found if inputs are restricted to the required literals and constants. Author

N65-19493# Rensselaer Polytechnic Inst., Troy, N. Y.
DESIGN AND STABILITY OF PHASE LOCKED LOOPS Final Report
Paul M. De Russo, Lawrence H. Michaels, and William G. Tuel, Jr. 1 Dec. 1964 114 p refs *Its* Rept.-435.27
(Contract AF 19(628)-3859)
(AFCRL-65-21; AD-612036)

It is shown that phase-locked loops with noise corrupted inputs can be represented by nonlinear differential equations with randomly varying coefficients. Conditions for the stability

of the linearized form of these equations are determined. The method (developed by Bershad) used in the stability analysis is that of bounding the n^{th}-order system impulse response with that of a first-order system, and determining where the first-order system is stable. The results of this analysis are then applied to second- and third-order systems to determine stability regions for these systems as a function of their parameters. These stability regions are experimentally verified. The effect of limiting of the random parameter and the nature of the Gaussian assumption are discussed. Parameter optimization is performed upon the second- and third-order systems to minimize their steady-state error to a noise-free ramp phase input, yielding the optimum filters for second- and third-order phase-locked loops. A comparison determines which of the two loops has a smaller steady-state error to a ramp phase input. Author

N65-19501*# Arizona Univ., Tucson.
RESEARCH IN AND APPLICATION OF MODERN AUTOMATIC CONTROL THEORY TO NUCLEAR ROCKET DYNAMICS AND CONTROL Progress Report, Feb. 1–Sep. 1, 1964
Lynn E. Weaver, Donald G. Schultz, David L. Hetrick, James L. Melsa, Hugh S. Murray et al Washington, NASA, Mar. 1965 196 p refs
(Grant NsG-490)
(NASA-CR-193) CFSTI: HC $5.00/MF $1.25

Progress is reported in (1) developing an approach to closed-loop suboptimal control employing the second method of Liapunov; (2) studying the application of the second method of Liapunov to the stability of clustered nuclear rocket engines, using realistic system models with true delay times; (3) determining a closed-loop control in the presence of measurement noise and external disturbances; and (4) evaluating various approximations to the response of a reactor to a constant rate of reactivity increase. M.P.G.

N65-19541# Joint Publications Research Service, Washington, D. C.
SIZE AND SHAPE OF CROSS SECTIONS OF MOLECULAR COMPLEXES PRODUCING ANOMALOUS FIELD EMISSION IN ORGANIC SEMICONDUCTORS
A. P. Komar and V. P. Savchenko 23 Mar. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 158, no. 6, 1964 p 1310–1313
(JPRS-29243; TT-65-30566) CFSTI: $1.00

Quantitative data on 600 bright patches in the shape of two-leaved and four-leaved figures of molecular complexes, in the copper phtalocyanin and anthraquinone adsorption onto tungsten points, were gained with the help of an ocular micrometer. It was found that the twos and fours were polymeric whiskers of the condensate that grew on the points. Comparison of the experimental ratio of the twos and fours circular cross section radii (0.773) with the ratio of (0.746) predicted by application of the waveguide theory, based on the assumed presence of delocalized electrons, confirms this observation. G.G.

N65-19767*# New York Univ., N. Y. Lab. for Electroscience Research
WIDE BAND PHASE DISTORTION EQUALIZATION Technical Memorandum No. 41
C. Capetanopoulos Jul. 1964 15 p
(Contract NAS5-3508)
(NASA-CR-57314) CFSTI: HC $1.00/MF $0.50

This report gives the design criteria for wideband phase realization. The design of passive lattice phase equalizers is introduced. These are all-pass passive networks that can correct the phase response of a particular system without affecting its amplitude response; they have the advantages of requiring no power and give reliable performance in many systems where phase equalization is required. The main part of this report consists of the design of a particular lattice equalizer whose phase vs frequency characteristic has the form of an S-curve. This particular phase characteristic can be used for phase correction in a wide variety of systems. One particularly effective method for almost any phase correction required is to cascade a number of these lattice networks designed for a so-called staggered arrangement. Author

N65-20031# Sperry Rand Corp., Blue Bell, Pa. UNIVAC Engineering Center
SYNTHESIS OF LOGIC FUNCTIONS ON AN ARRAY OF INTEGRATED CIRCUITS Scientific Report No. 2, Nov. 1963–Oct. 1964
Lester M. Spandorfer and John V. Murphy Bedford, Mass., AFCRL, 31 Oct. 1964 81 p refs
(Contract AF 19(628)-2907)
(AFCRL-64-908; AD-611809)

This report considers the problem of synthesizing large-scale logic on an array of microcircuits. Emphasis is placed on the continued development of planar logic, which permits fabrication of all logic interconnection lines on a single layer. A major goal is the study of the applicability of planar logic to the problem of fabricating simple neighborhood-connected arrays of cells. Types of crossovers are defined; the planar theorem is reviewed and its applicability to contact-type networks described. A number of general triangular and rectangular neighbor-connected planar arrays are also described as are general planar synthesis techniques, efficient forms of logic crossovers, and methods of collapsing trees. A special method for the efficient synthesis of planar symmetric functions is shown. An extension to the theory of cascade or Sklansky tributary structures is developed. Author

N65-20051# Northwestern Univ., Evanston, Ill. Computer Sciences Lab.
TIME-OPTIMAL CONTROL OF DISCRETE SYSTEMS SUBJECT TO INPUT SATURATION
Julius T. Tou and W. J. Hankley May 1964 93 p refs
(Contract Nonr-1228(23); Grant NSF G-24900)
(TR-105; AD-600289)

An alternative solution to the time-optimal control problem by extending the method of coordinate transformation is presented. The solution is developed in the form of a control law, an algorithm which may be realized as an on-line digital controller. The control law specifies a feedback control structure and, as such, is adaptive with respect to system disturbances and nonideal systems. It is emphasized that the basic structure of the control laws is applicable to all linear stationary systems regardless of the order of the system, or the nature of the poles and zeros, or the number of inputs. Flow charts for the controller for the regulator problem, and of the control algorithm for multiple input systems are included. E.E.B.

N65-20071# Bell Telephone Labs., Inc., New York.
MICROWAVE DIODE RESEARCH Ninth Quarterly Progress Report, 10 Jun.–9 Sep. 1964

J. J. Chang, D. F. Ciccolella, B. C. De Loach, R. D. Hempstead, J. C. Irvin et al 20 Dec. 1964 64 p refs
(Contract DA-36-039-SC-89205)
(Rept.-18; AD-456531)

Analyses are presented to compare various doping profiles of varactors with a view to determining optimum design criteria. It is found that for highly efficient harmonic generators, the optimum doping profile should emphasize low loss rather than large-capacitance variation. The weighting of resistance–capacitance variation factors depends on the particular application. Further data on the transient behavior of PIN diodes are presented. A model is proposed which explains the observation that the reverse bias microwave impedance under transient conditions can be many times the value predicted for a uniform distribution of stored charge. Author

N65-20078# New York Univ., N. Y. Lab. for Electroscience Research
RESEARCH INVESTIGATIONS IN SYSTEMS THEORY Final Report, Oct. 1, 1963–Sep. 30, 1964
J. K. Wolf and J. R. Ragazzini 1 Oct. 1964 21 p refs
(Grant AF-AFOSR-499-64)
(AFOSR-64-2176; AD-609450)

A summary is presented of work on the basic unifying concepts of physical systems covered by such areas as communications theory, information theory, and control theory. Specific topics discussed include error-location codes, cumulative decision feedback, approximately optimal control systems, time-optimal controls for continuous and sampled data systems, multiple-loop feedback amplifiers, and digital filters and spectral analysis. Abstracts are given of three doctoral dissertations and six published papers. D.E.W.

N65-20092# Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research
ON THE OPTIMUM REGULATOR MATRIX OF THE MULTIVARIABLE SYSTEM IN THE WIENER SENSE
W. Ciechanowicz Nov. 1964 16 p refs
(Rept.-562/IX)

The paper is concerned with obtaining the regulator matrix of the multivariable system as a optimum matrix in the Wiener sense. This is done by the assumption that only the disturbances of the system have the noise signal components, and not the command signals. Another assumption is that considered random processes are stationary. Author

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N65-18649# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WIND TUNNEL FOR STUDYING TWO-BLADED GRIDS AT GREATER FLOW-THROUGH VELOCITIES
Wojciech Brzozowski 27 Nov. 1964 29 p refs Transl. into ENGLISH from Prace Inst. Maszyn Przeplywowych, Polska Akad. Nauk (Warsaw), no. 4, 1961 p 13–41
(FTD-TT-64-96/1+2; AD-453067)

New wind tunnel equipment is described for the investigation of blade grids in flat flow through at near-sonic velocities. The experience gained from the operation of previous installations led to the concept of a stand in which, as it appears, a series of measurement difficulties has been eliminated. Measurement results obtained from the operation of this wind tunnel confirmed previous assumptions. A series of flow-through photos, taken by the Schlieren-type equipment, was also added. Author

N65-18804* National Aeronautics and Space Administration, Washington, D. C.
THE SELECTION AND CONSTRUCTION OF NEW TEST GROUNDS
Hideo Itogawa *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 49–60 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Selection of a new launching site for testing Kappa rockets in the Japanese space program is described. Five possible sites were evaluated with respect to (1) distance from forests, (2) distance from residential areas, (3) accessibility by roads, (4) proximity to lake or sea, and (5) cooperation from local citizens and government. The Ohsumi Peninsula was chosen to replace the site at Akita. J.M.D.

N65-18821* National Aeronautics and Space Administration, Washington, D. C.
THE THRUST METER FOR GROUND TEST OF THE LAMBDA SERIES ROCKET ENGINE
Koshiro Ohi, Owao Yoshiyama, Kotatsu Kokura, and Takashi Tokimatsu *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 136–143 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

An accurate thrust meter with 50-ton capacity was developed for the Lambda-735 1/3 rocket engine in the Japanese space program. The meter design is presented. Test data are shown on relative strain, load, and stress. The meter was corrected over the load range 0–50 tons. Oscilloscope correction plots from combustion tests differed by less than 1.5% from the results of an earlier test. The measured ratio of longitudinal stress to transverse stress was 10:3; from this, it was concluded that thrust-force pickup was quite good. J.M.D.

N65-18838* National Aeronautics and Space Administration, Washington, D. C.
GROUND TEST OF LAMBDA TYPE ENGINES (735 ϕ-1/3, -2/3 AND -3/3 TYPE) Thirty-seventh Report on Research of the Optical Tracking of a High-Speed, Moving Body
Hisaaki Uemura, Katsuya Tanaka, Kazuo Kanezawa, Yutaka Kikusato, and Sei-ich Okamiya *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 263–266 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The optical observation team filmed the flame at the nozzle of the rocket engine. Internal pressure, internal pressure-vibration, thrust, stress, vibrational sound, and humidity were measured. Color film was used in both cameras and the flame and smoke were clearly seen. The effect was good for the L-735-3/3 type rocket engine test when there was extremely

bad weather. In order to take complete and continuous film of a combustion which lasts more than 10 to 20 seconds, two cameras were set in series. R.W.H.

N65-18850* National Aeronautics and Space Administration, Washington, D. C.
BRIEF OUTLINE OF KAGOSHIMA SPACE CENTER CONSTRUCTION
Takakazu Maruyasu, Yoshio Nakamura, and Shamei Tsuda *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 377–384 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The Tokyo University Kagoshima Space Center was planned to be constructed in the town of Uchinoura, in Kagoshima Province. Construction to date consists of preparing the land, network of roads, and installation of the necessary facilities, buildings and other construction. R.W.H.

N65-18851* National Aeronautics and Space Administration, Washington, D. C.
THE GROUND FACILITIES OF KAGOSHIMA SPACE CENTER
Norihumi Saido, Iwaho Yoshida, and Hirosumi Takanaka *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 385–392 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The main purpose of the project was to get effective communications for space rocket flight experiments between the control center and other local centers (rocket, telemetry, radar, radio and computing centers). The project is designed so that when a rocket is launched, all the information necessary for the flight can be obtained precisely and quickly. R.W.H.

N65-18855# ARO, Inc., Arnold Air Force Station, Tenn.
A TECHNIQUE FOR PRODUCING VERY LOW AMBIENT DENSITIES IN GROUND TEST FACILITIES DURING TESTS OF ROCKET ENGINES Technical Report, Mar. 8, 1962–Aug. 1, 1964
D. Taylor, R. C. Bauer, and M. Simmons Arnold Eng. Develop. Center, Feb. 1965 44 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-14; AD-457893)

An experimental test program was conducted to develop a technique for producing very low ambient pressures (10^{-2} to 10^{-3} mm HgA) in ground test facilities during the operation of rocket engines. A small model of a liquid-fueled rocket engine having a chamber pressure of 500 psia and a nozzle area ratio of 45 was tested in a 6.63-in.-diameter cylindrical diffuser, which was equipped with diverging conical inlet sections having half-angles of 18° to 54°. The test cell was equipped with a pumping system, which operated in parallel with the rocket engine diffuser. The optimum configuration tested produced test cell pressures of 15×10^{-3} mm HgA. The base pressure theory developed by Korst and Chapman modified to account for axisymmetric effect is experimentally verified. Author

N65-18916*# Dames and Moore, Los Angeles, Calif.
TESTS TO EXPERIMENTALLY DETERMINE THE NATURAL FREQUENCIES OF THE SATURN S-IC TEST STAND, PHASE I
David J. Leeds and Vernon A. Smoots 8 Feb. 1965 33 p refs
(Contract NAS8-11842)
(NASA-CR-57160) CFSTI: HC $2.00/MF $0.50

The structural dynamic characteristics of the Saturn S-IC test stand at the Marshall Space Flight Center, were measured during forced horizontal vibrations at several force levels. A structural vibrator was used to produce vibrations at specific frequencies on the empty test stand. Response of the structure to precisely controlled input forces, activated separately for the two horizontal components and at two separate levels, was recorded. Resonant frequencies and damping values were computed from the records. Author

N65-18922*# National Aeronautics and Space Administration. North Eastern Office, Cambridge, Mass.
THE MISSION OF THE ELECTRONICS RESEARCH CENTER News Release
Winston E. Kock [1964] 11 p Presented at the Northeast Electron. Res. and Eng. Meeting, Boston, 4 Nov. 1964 Available from the Scientific and Technical Information Division

Dr. Winston E. Kock from the National Aeronautics and Space Administration outlined the research activities at the Boston Electronics Research Center. This facility will carry out inhouse research to establish and maintain a NASA capability for securing the best in electronics for all NASA missions. The structure of the Center's organizational chart is discussed, and the objectives of the various divisions are presented. G.G.

N65-18954# Edgerton, Germeshausen and Grier, Inc., Boston, Mass.
MOBILE RADIOLOGICAL MEASURING UNIT: DESCRIPTION AND OPERATING INFORMATION
Z. G. Burson, R. L. Summers, and J. T. Brashears Washington, AEC, Feb. 1965 48 p refs
(CEX-63.11) CFSTI: $1.00

The Mobile Radiological Measuring Unit (MRMU) is a remotely controlled vehicle-mounted device that uses a moving radioactive source hydraulically pumped through polyethylene tubing at a uniform rate of speed to simulate a blanket of radioactive fallout material on an area. It can also simulate a line source at a particular radius by pumping the captive source through tubing placed at the desired radius. The captive source can also be transported, within a matter of seconds, from its shield to a precise location for a variety of point-source radiation studies. Given here is a description of the MRMU, detailed operating information, emergency procedures, and health physics operating regulations. R.L.K.

N65-19039# Weapons Research Establishment (Australia). Dept. of Supply
SOUND AND VIBRATION MEASUREMENTS IN THE BURN-OFF FRAME AREA, TEST POST 6A, LAUNCHER AREA 6
A. E. Hicks Dec. 1964 9 p
(WRE-TN-EC-14)

Recordings of the sound and vibration intensities in the burnoff frame area underneath the 6A Launcher Emplacement were made during the live firings of the Blue Streak Rocket F1, on June 5, 1964. The method of obtaining these records and a summary of the results are contained in this technical note. Author

N65-19056# General Dynamics/Astronautics, San Diego, Calif.
PREDICTED PERFORMANCE, GLOBAL TRACKING NETWORK AT AMR
D. C. Prim and L. N. Lawhead [1963] 12 p

The major elements of the Global Tracking Network are described, and a brief discussion of their individual capabilities

is presented. The performance of ground stations assigned to Segment 1 at AMR is examined based on computer simulations and on an informal tracking test in connection with MA-9 Mercury Launch. Author

N65-19278*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DESCRIPTION AND INITIAL CALIBRATION OF THE LANGLEY 12-INCH HYPERSONIC CERAMIC-HEATED TUNNEL
Louis E. Clark Washington, NASA, Mar. 1965 54 p refs
(NASA-TN-D-2703) CFSTI: HC $3.00/MF $0.50

This facility is a free-jet wind tunnel utilizing a pebble-bed heat exchanger to provide condensation-free flow at Mach 13.6. Pitot pressure surveys showed that the conical nozzle produces a flow satisfactory for many types of testing over a range of stagnation pressure from 60 to 615 psia and at stagnation temperatures from 2460° to 3750° R. The uniform core of the 12-in.-diameter nozzle decreased from 7 in. in diameter at 615 psia to 5.5 inches at 65 psia. The axial Mach number gradient decreased from 0.13 per in. at 615 psia to 0.07 per in. at 80 psia. Total-temperature measurements indicate a maximum total temperature of 3750° R. Total-temperature surveys showed the core of uniform temperature to be smaller than the Mach number core and slightly asymmetric. The tunnel airstream had a small amount of ceramic-dust contamination which should be insignificant for most tests. Tunnel pressure recoveries with relatively large models installed decreased from 60% to 65% of normal shock recovery to 35% to 45% as the stagnation pressure was decreased from 615 to 80 psia. The maximum size of the model which could be operated was found to decrease with stagnation pressure from a 5-in.-diameter 60° cone to a 4-in.-diameter 60° cone.
Author

N65-19323# Naval Research Lab., Washington, D. C. Nucleonics Div.
DIGITAL COMPUTER STUDIES OF ELECTRON GUNS Interim Report
Richard T. Close 30 Nov. 1964 14 p refs
(NRL-6174; AD-609679)

A digital computer program is being used to solve the electron gun problem to a certain degree of approximation. Certain phenomena have been observed in the numerical solution such as the choice of the perveance density influencing the convergence and final results. These phenomena are not completely understood; however, experience has provided guidelines to effective use of the program. Author

N65-19414# Technology, Inc., Dayton, Ohio.
DESIGN AND OPERATION OF A SPACE RENDEZVOUS SIMULATOR Technical Report, 1 Nov. 1963–5 Jun. 1964
Robert A. Schmall and Thomas J. Wittmann Wright-Patterson AFB, Ohio, AF Aero Propulsion Lab., Nov. 1964 29 p
(Contract AF 33(615)-1125)
(AFAPL-TR-64-130; AD-609748)

A one-degree-of-freedom rendezvous simulator was designed and constructed to simulate a 2500-foot rendezvous to determine an astronaut's ability to make a tolerable impact upon a spacecraft when the astronaut is propelled from a first spacecraft by a self-contained, six-degree-of-freedom Astronaut Maneuvering Unit (AMU). Conducted in a 270-foot, light-tight photometric tunnel, each run comprised two portions—one with a illuminated target appropriately increasing in size to give the effect of motion while subject and target remained stationary, and the other with the target full size while a lightweight cart carried the target along the tunnel tracks to produce actual motion. Test results from 30 human subjects revealed that AMU's 20-pound retrothrust would be more than adequate to decelerate from the test closing velocities to a tolerable impact. Autokinetic effects causing the appearance of false target movement and other effects, such as those which might result from a stellar background and a subject's having two or more angular degrees of freedom, prompted recommendations for provisions to be incorporated in a future test facility. Author

N65-19418# Federal Aviation Agency, Atlantic City, N. J. Research Div.
ANALYSIS OF APPROACH LIGHTING CONFIGURATIONS FOR VISUAL TRANSITION UNDER CATEGORY II OPERATING CONDITIONS Interim Report
Robert K. Mc Kelvey and Guy S. Brown Sep. 1964 90 p
(FAA-RD-64-134)

Three experiments were conducted to determine requirements for modification of the present U. S. National Standard Approach Lighting System (Configuration A) to meet Category II visibility operating requirements (1200-ft Runway Visual Range). A building-blocks approach was used in which each increment in configuration complexity had to be justified on the basis of a demonstrated gain in performance while the pilot is being systematically exercised in the use of the system. The experiments were conducted in a visual landing simulator. The results indicate that satisfactory performance of visual transition for landing can be achieved with a basic center row and crossbar configuration, including sequence flashing lights operated to the point of acquisition of the steady burning light components of the system. Author

N65-19432# Naval Ordnance Test Station, China Lake, Calif. Underwater Ordnance Dept.
THE LCU 1446 MOBILE TEST FACILITY
Nov. 1964 23 p
(NOTS-TP-3452; NAVWEPS-8485; AD-609878)

Development of a mobile sea-test facility, the LCU 1446, and pertinent characteristics of its major components are detailed. Special features of the craft, the underwater launcher, the static firing pad, and the deep-water recovery system are described. Particulars include current assignments for generating data related to firing an underwater missile from a fixed launcher, static firing of a rocket motor under water, and recovery of expended ordnance from deep water. Conjunctive assignments are diverse. Author

N65-19451# RAND Corp., Santa Monica, Calif.
A GENERALIZED ANALYSIS OF THE PERFORMANCE CHARACTERISTICS AND OPERATING RANGES OF HYPERSONIC-FLOW TEST FACILITIES
A. F. Charwat Jan. 1965 146 p refs
(Contract AF 49(638)-700; Proj. RAND)
(R-432-PR; AD-458219)

This analysis attempts to (1) single out the significant characteristics of each design element; (2) express characteristics in terms of dimensionless parameters as functions of the Mach number and the Reynolds number; and (3) plot a map using Mach–Reynolds coordinates, of lines of constant value of these operational parameters. Also, physical and mathematical approximations made in the derivations

and generalizations are justified. The results obtained from the analysis are compared with data from actual practice and were found to portray very well the characteristics of existing facilities. E.E.B.

N65-19452# Aberdeen Proving Ground, Md. Interior Ballistics Lab.
AN IMPROVED VISCOELASTIC TORSION PENDULUM
William Goldberg Nov. 1964 35 p refs
(BRL-TN-1550; AD-458902)

An apparatus is described for the measurement of the complex shear modulus of viscoelastic materials. The apparatus consists of a modified Nonius torsion pendulum driven in forced vibration by either a low frequency sinusoidal current or by a constant current source. The specimens tested may be either circular or rectangular in cross section. The frequency range of the apparatus is 0.001 to 3 cps. Calibration of the pendulum, reduction of the data, and examples of typical results are presented. Author

N65-19572# Illinois Univ., Urbana. Dept. of Chemistry
A SHOCK TUBE WITH QUADRUPOLE MASS FILTER FOR MONITORING HIGH-TEMPEATURE REACTION KINETICS Research (Interim) Report No. 1, 1 Jan. 1962–1 Sep. 1964
David Gutman, Arthur J. Hay, and R. L. Belford Sep. 1964 51 p refs
(Grants AF-AFOSR-62-245; AF-AFOSR-588-64)
(AFOSR-64-2410; AD-609775)

Equipment necessary for the study of fast chemical reactions with shock tube and mass spectrometer techniques is discussed in detail. Shock studies in nonreacting systems were conducted to calibrate the apparatus and to determine its limits of sensitivity and range of applicability. Preliminary test results were obtained in the form of ion current vs time for pure argon and for dilute nitrogen in argon. A preliminary test of the N_2O dissociation was performed. E.E.B.

N65-19658# California Univ., Livermore. Lawrence Radiation Lab.
THE GAS ANALYTICAL APPARATUS FOR PROJECT DRIBBLE
J. Frazer, V. Du Val, and Clarence Morris 6 Jan. 1965 19 p refs
(Contract W-7405-ENG-48)
(UCRL-12169) CFSTI: $1.00

The design and operating characteristics of the gas analytical apparatus constructed for the Salmon event of Project Dribble are described. The apparatus under normal working conditions has the following sensitivities: 5 ppm for hydrogen, 15 ppm for oxygen and nitrogen, and 100 ppm for sulfur dioxide. The thermistor signal-to-noise ratio is approximately 5μV peak-to-peak as measured on a 1-mV recorder. E.E.B.

N65-19673# American Meteorological Society, Boston, Mass.
APPARATUS FOR HIGH-PRESSURE RESEARCH [ISSLEDOVATEL'SKIE APPARATY VYSOKOGO DAVLENIIA]
V. A. Galaktionov Jul. 1964 9 p Transl. into ENGLISH from Vestn. Akad. Nauk SSSR (Moscow), no. 7, 1962 p 73–76
(Contract AF 19(628)-3880)
(AD-609172)

Methods for the development of high-pressure apparatus are reviewed. Various types of high-pressure chambers and a few examples of molecular structural rearrangement by means of high-pressure techniques are included. E.E.B.

N65-19694*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
A PROCEDURE TO ANALYZE AND EVALUATE ALTERNATIVE SPACE PROGRAM PLANS
H. H. Koelle and R. G. Voss, ed. 3 Mar. 1965 127 p
(NASA-TM-X-53212) CFSTI: HC $4.00/MF $1.00

This document summarizes the description of a space program simulation procedure, including required inputs and desirable outputs, which is tailored to evaluate a space program on a national basis. The Program Analysis and Evaluation Procedure (PAEP) can be best summarized by outlining its major functional steps: (1) select project–time relationships; (2) select emphasis for each project; (3) describe and assign space vehicles and destination payloads; (4) combine projects into different space program plan alternatives; (5) cost all elements of each project and add or prorate cost burdens; (6) calculate project yield; (7) calculate selected yield to cost ratios; (8) calculate total program worth; (9) divide total program worth by cost, obtaining a measure of program effectiveness; and (10) develop a most desirable national space program that can be used as a baseline for further repetitive analysis and refinement. Author

N65-19698*# National Academy of Sciences—National Research Council, Washington, D. C. Div. of Biology and Agriculture
REPORT OF TRAVEL GRANTS TO THE INTERNATIONAL BIOPHYSICS MEETING, PARIS, JUNE 22–27, 1964
[1964] 35 p
(Grant NsG-638)
(NASA-CR-57321) CFSTI: HC $2.00/MF $0.50

The recipients of travel grants to the International Biophysics Meeting in Paris, June 1964 are listed, and a short outline of the scientific program for this symposium is given. The membership lists of the International Organization for Pure and Applied Biophysics and of the United States National Committee for Pure and Applied Biophysics are attached. G.G.

N65-19797# Midwestern Universities Research Association, Madison, Wis.
PREACCELERATOR COLUMN DESIGN
C. D. Curtis and G. M. Lee 15 Feb. 1965 18 p refs Prepared for ANL
(MURA-707)

The design of an accelerating column for proton beams of 200–400 mA requires special attention to space charge forces if distortions of beam emittance due to aberrations are to be avoided. A high gradient column design to accelerate a large diameter beam in a converging spherical field is presented. The reentrant structure of titanium and stainless steel electrodes has good ion source accessibility and is designed to operate at 750 kV with a 30-cm accelerating gap. The ceramic column of 21-inch length resides in a pressurized atmosphere, which is contained by a filament-wound fiber glass vessel 3-1/2 feet in diameter and 7 feet in length. Author

N65-19798# Midwestern Universities Research Association, Madison, Wis.
PRELIMINARY DESIGN DEVELOPMENT OF A VACUUM CHAMBER FOR THE ARGONNE ZGS
G. M. Lee, J. E. O'Meara, and W. R. Winter 1 Mar. 1965 12 p ref Prepared for ANL
(MURA-711)

A vacuum chamber for the Argonne Zero Gradient Synchrotron must be able to withstand full atmospheric

load without suffering permanent deformation, and to operate in a region of high radiation without loss of vacuum or structural integrity and in a pulsing magnetic field with a minimum of eddy current effects. The development of a possible design is given. Author

N65-19819# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
TECHNICAL FOUNDATIONS FOR FUTURE AEROSPACE VEHICLES
George T. Buck, Jr. Dec. 1964 75 p 3d ed.

General information on the operational mission, organizational structure, and facilities of the Air Force Flight Dynamics Laboratory is presented. The missions of the five laboratory divisions collectively cover all the technical areas associated with conception, design, and preliminary development of flight vehicles. R.C.S.

N65-19821# Vitro Engineering Co., New York.
PRELIMINARY DESIGN REPORT. TITLE I: MOBILE GAMMA IRRADIATOR
H. Lowenberg Oak Ridge, Tenn., AEC, 30 Oct. 1964 98 p ref
(Contract AT(30-1)-3389)
(KLX-1866) CFSTI: $3.00

The mobile gamma irradiator (MGI) is a semiproduction, transportable unit for irradiating fruit and farm produce, with the capability of furnishing dosages in the pasteurization range. The irradiator consists of a lead filled carbon steel shield vessel with a removable top. A double chambered reciprocating shielded shuttle is provided at one end of the vessel for carrying the product in and out of the irradiation chamber. By means of a series of dwell cycles, the product carrier automatically traverses every required internal position so that the product receives the necessary dose. A detachable cask for the source plaque is provided at the other end of the irradiator. The MGI is mounted on a trailer with the cask end oriented towards the rear of the trailer for easy cask removal. E.P.V.

N65-19836# Atomic Energy Commission, New York. Health and Safety Lab.
DETERMINATION OF ENERGY DISTRIBUTION OF X-RAY BEAMS FROM A 250 KV CONSTANT POTENTIAL MACHINE
Arthur Shambon Nov. 1964 38 p refs
(HASL-151) CFSTI: $2.00

An X-ray facility suitable for the energy calibration of radiation-detection devices is described. The energy distribution of the useful beam from a 250 kV constant potential X-ray machine is established through the evaluation of the X-ray machine's kilovoltage scale and the determination both theoretically and experimentally of the inherent filtration. The radiation fields at three positions in both filtered and unfiltered beams are found, and the transmitted energy passing through materials of the X-ray machine and other filters is calculated. Author

N65-19850*# Northrop Space Labs., Huntsville, Ala.
APOLLO LOGISTIC SUPPORT SYSTEMS MOLAB STUDIES: MISSION COMMAND AND CONTROL Interim Report
Arch W. Meagher and Robert J. Bonham Huntsville, Ala., NASA, Marshall Space Flight Center, 8 Jan. 1965 116 p refs
(Contract NAS8-11096)
(NASA-CR-61040) CFSTI: HC $4.00/MF $0.75

Critical stability areas and limits are established for two lunar surface vehicles (LSV). Motion equations, a mathematical model, and results of pitch and roll plane studies are presented for a four-wheel LSV, and pitch and roll plane motion equations are derived for a six-wheel articulated LSV. In both cases a particular vehicle with specified parameters is studied. A preliminary block-diagram study of the LSV command and control systems is included. E.P.V.

N65-19885*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ESTIMATED 1963–1970 CAPABILITY OF THE DEEP SPACE INSTRUMENTATION FACILITY FOR APOLLO PROJECT
E. Rechtin 1 Feb. 1962 54 p refs Revision 1
(NASA-CR-57506; EPD-29, Rev. 1) CFSTI: HC $3.00/MF $0.50

The geometry and coverage of the three Deep Space Stations (DSS) are described in detail by text, photographs, maps, and diagrams. The capabilities of the Deep Space Instrumentation Facility (DSIF) system are discussed in terms of their stages of planning or operation and by category, such as tracking, communications, subsystem characteristics, and testing and checkout. Other sections briefly consider the Space Flight Operations Facility; and relationships of DSIF to foreign governments and operating agencies and to the Apollo Project Office; DSIF interface with other networks and with contractor-supplied equipment; and reference documents. D.E.W.

N65-19918*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
TECHNIQUES FOR IMPROVING THE OPENING OF THE MAIN DIAPHRAGM IN A LARGE COMBUSTION DRIVER
Robert E. Dannenberg and David A. Stewart Washington, NASA, Mar. 1965 18 p refs
(NASA-TN-D-2735) CFSTI: HC $1.00/MF $0.50

Refinements in operating techniques to improve the piercing process and the lobe formation of the main diaphragm in a large combustion driver are described. Problems associated with time variations in the driver combustion process as they affect the form of the diaphragm petalling are discussed. The use of a Pierce Analog System (PAS) to actuate the diaphragm punch is shown to be beneficial from the standpoint of diaphragm lobe shaping, full utilization of the combustion energy, and reduction in the scatter in the run-to-run primary shock velocity. Consistent opening of a diaphragm into four triangular-shaped lobes is shown to be attained with the use of a properly designed piercing head. Author

N65-19951# General Electric Co., Santa Barbara, Calif. Technical Military Planning Operation
PRELIMINARY FUNCTIONAL DESIGN OF MISSILE GROUND SUPPORT SYSTEMS
William B. Thompson 1 Oct. 1959 84 p refs
(RM-59-TMP-45)

This study presents methods for resolving problems encountered by the systems designer in the early development stages of a missile ground support system. The emphasis is on the design and employment of ground test and control equipment. The operational requirements (or mission profile) of ground support equipment are related to the mission requirements of the system as a whole. Ground control equipments with continuous critical profiles together with all airborn functional subassemblies (or black boxes) are defined as primary units. The hypothesis is advanced that all primary units of the system should be checked out occasionally

to determine operability. This should be done at launch site if possible. Modes in which the primary units of the system may be tested at launch site are considered. Four such test modes are examined, and formulas for computing the key indicators of system effectiveness under each mode are derived. Author

N65-20052# ITT Federal Labs., Nutley, N. J.
APPLIED RESEARCH STUDY ON SATELLITE COMMUNICATIONS. MOBILE GROUND STATIONS. PART III EQUIPMENT STUDIES. VOLUME I: GENERAL MOBILE STATION INVESTIGATIONS Task Report, 1 Jul. 1962–31 Dec. 1963
E. Singer, A. Werth, H. Silver, W. Spanos, and M. Hoffman Mar. 1964 194 p refs
(Contract DA-36-039-SC-90886)
(TD64-97; AD-458522)

The boundary conditions and preliminary design of a Land Mobile Communications Station (LMCS) are presented. The design is based on certain assumptions regarding the satellite system to be used, and typical one-shelter-plus-power-generator design is discussed. The design of a super transpportable LMCS based on very specific satellite system specifications is developed in considerable detail, and the specific problem of antenna design is considered. Several configurations, including phased arrays, arrays of parabolas, and Luneberg lenses, are investigated, followed by a description of the sea environment and shipborne communications stations, with particular emphasis on the antenna problem. A similar discussion with regard to airborne systems is then presented. Supporting areas to this task, including vocoders, companders, and modulation techniques, are also discussed. Author

N65-20059# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
A WATER TUNNEL AIR CONTENT METER Project Report No. 70
John M. Killen and John F. Ripken Feb. 1964 48 p refs
(Contract Nonr-710(42))
(AD-606687)

A system for measuring the size and concentration of free air bubble nuclei in the limited ranges of size and concentration thought to exist in a water tunnel is described. This system is based on measuring the amplitude attenuation of an acoustic pulse of sound as it is propagated across a water tunnel test section. An arbitrary method is proposed for converting the measured sound attenuation into size and concentration of air bubbles. Author

N65-20068# Toronto Univ. (Ontario). Inst. for Aerospace Studies
SHOCK AND COMBUSTION-WAVE DYNAMICS IN AN IMPLOSION-DRIVEN HYPERVELOCITY LAUNCHER
I. I. Glass Jan. 1965 45 p refs
(Contract AF 33(657)-7874)
(UTIAS-25; AD-457981)

In order to solve many existing problems in planetary entry it is necessary to have facilities that are capable of launching undamaged projectiles at hypervelocities in excess of 50 000 ft/sec. Unfortunately, conventional light-gas guns appear to have reached a velocity plateau of about 30 000 ft/sec or less for launching integral aerodynamic models. It is shown that, by a novel application of combustion-wave and shock-wave dynamics in gases and explosives, it is theoretically possible to achieve projectile velocities in the desired hypervelocity range. Some details are presented of the analysis and of the research results obtained to date on spherical combustion of stoichiometric mixtures of oxygen and hydrogen diluted with helium or hydrogen, the initiation of propellants and explosives by using deflagration and detonation waves, and some initial launchings. Author

N65-20074# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
A CONTROLLED THERMAL ENVIRONMENT FOR DIELECTRIC BREAKDOWN STRENGTH STUDIES
L. J. Seligman Feb. 1965 23 p refs
(SC-RR-64-602) CFSTI: $2.00

A glass temperature chamber was designed in which the dielectric strength of material specimens may be tested in a dielectric fluid. The temperature range of the chamber (−10° to +210° C) is established in an auxiliary heat exchanger which supplies or removes heat as the dielectric fluid is pumped to the specimen, raising or lowering its temperature. Data from two studies of dielectric strength versus temperature, using high-voltage pulses, are compared with theory. Author

N65-20081# Los Alamos Scientific Lab., N. Mex.
THE POWER CROWBAR ENERGY SYSTEM FOR SCYLLA IV
E. L. Kemp and W. E. Quinn 10 Mar. 1965 23 p refs
(Contract W-7405-ENG-36)
(LA-3189-MS) CFSTI: $1.00

The energy storage system of Scylla IV has four capacitor banks, which are applied in the following order: (1) the reverse bias bank—10 kV, 280 kJ, with a rise time of 60 μsec; (2) the preionization bank—40 kV, 9 kJ, that rings at 300 kc; (3) the primary bank—50 kV, 540 kJ, with a rise time of 3.7 μsec; and (4) the power crowbar bank—20 kV, 3 MJ, with a rise time of 25 μsec. The switch of the fourth bank must hold off the pulse voltages applied by the other three banks while also holding off the dc voltage of the power crowbar bank. It must also fire with low jitter when the voltage across it is near zero. Three types of switches for this application are discussed: a 20-kV ignitron, a developmental 50-kV ignitron, and a vacuum spark gap. Various methods of triggering the preferred vacuum switch are presented. A washer gun, chosen as the trigger for each gap, is discussed. The 3-MJ capacitor bank is examined as a system which includes the capacitor protection scheme, the prefire protection circuit, and the complete firing system. Author

N65-20107*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE CONSTRICTED-ARC SUPERSONIC JET
Charles E. Shepard [1963] 17 p ref Presented at the 19th Semiann. Meeting of the Supersonic Tunnel Assoc., Ottawa, 16–17 May 1963
(NASA-TM-X-56181) CSFTI: HC $1.00/MF $0.50

A brief description of the constricted-arc supersonic jet, experimental data showing the performance of the device, and a comparison of experimental results with the theory of Stine and Watson are presented. It was concluded that: (1) An arc can be passed entirely through a supersonic nozzle without disrupting the flow. (2) Average enthalpies of 30 000 Btu/lb in nitrogen have been obtained. (3) Local measurements show that the stagnation enthalpy and heat loss to the wall increase exponentially with distance along the constrictor tube. (4) Radial profiles of impact pressure and stagnation heat transfer indicate that the enthalpy profile is sharply peaked at the center line of the jet. E.E.B.

N65-20109*# National Aeronautics and Space Administration, John F. Kennedy Space Center
SOLID PROPELLANTS SAFETY HANDBOOK
1 Feb. 1965 63 p refs
(NASA-TM-X-56192; SP-4-45-S) CSFTI: HC $3.00/MF $0.75

The purposes of the handbook are to familiarize personnel engaged in solid propellant operations with the hazards associated with solid propellant handling, storage, transportation, etc.; to help personnel select the most appropriate action; and to recommend procedures to minimize the hazards of solid propellant operations. The safety organization of the Kennedy Space Center is described. Solid propellants, associated hazards, safety precautions, safety procedures, safety limits, and safety material are discussed. E.E.B.

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N65-18633# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REFLECTION OF SUDDEN CHANGES IN DENSITY FROM THE AXIS OF SYMMETRY
D. A. Mel'nikov 29 Mar. 1963 15 p ref Transl. into ENGLISH from Izv. Akad. Nauk SSSR, OTD. Tekhn. Nauk: Mekh. i Mashinostr., no. 3, 1962 p 24–30
(FTD-TT-62-1785/1+2; AD-402427)

Problems associated with the flow of gas from a nozzle in the region of reflection from the axis of symmetry are a sudden change in density and the formation of a central jump converting supersonic flow into subsonic flow. The possibility of reflecting such an incident jump in condensation from the axis of symmetry without the formation of a subsonic flow is demonstrated. R.W.H.

N65-18644# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW PAST A PLATE AT HIGH SUPERSONIC VELOCITIES
V. I. Kholyavko 18 Jun. 1963 12 p refs Transl. into ENGLISH from Izv. Akad. SSSR, Otd. Tekhn. Nauk: Mekhan i Mashinostr. (Moscow), v. 5, 1962 p 26–31
(FTD-TT-64-485/1+2+4; AD-410058)

An equation is introduced to determine the position of a shock wave. For this, integral ratios of the law of conservation of energy, momentum, and mass are applied to a volume of gas enclosed between a piston and the shock wave. The width of the gas layer is assumed to be unity, and the initial pressure is disregarded. The solution is then carried out by using distribution of parameters in the transverse layer between the piston and the shock wave. Particular cases are examined for symmetrical flow past a blunt plate, and for the determination of the aerodynamic characteristics of a flat blunt plate with flow past at high supersonic velocities at small angles of attack. Further, the total lift coefficient is obtained by considering the pressure on the leading part of the plate. E.E.B.

N65-18651# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DISCONTINUOUS FLOW OF A COMPRESSIBLE FLUID PERPENDICULAR TO A PLATE
Momcilo Zdravkovic 3 Feb. 1965 27 p refs Transl. into ENGLISH from Tehnika (Belgrade), no. 4, 1963 p 611–620
(FTD-TT-64-496/1+2; AD-457896)

The general equation for incompressible fluid flow around a flat plate at a given distance from an open channel yields the effects of the plate on a free-stream jet, on closed channel flow, and on an infinite stream. Typical equations are derived for stream lines and drag coefficients, and treated by Chaplygin's transformation in the conjugal plane of compressible flow. The stream line equations are analyzed for the compressible case, where density is a new variable. The change in drag coefficient with Mach number and density is tabulated for all cases, and practical application to the correction of aerodynamic coefficients determined in wind-tunnel tests is discussed. E.P.V.

N65-18660# Naval Ordnance Lab., White Oak, Md.
EXPERIMENTAL REYNOLDS ANALOGY FACTOR FOR A COMPRESSIBLE TURBULENT BOUNDARY LAYER WITH A PRESSURE GRADIENT Aerodynamics Research Report No. 234
Lionel Pasiuk, Samuel M. Hastings, and Rodney Chatham Feb. 1965 55 p refs
(NOLTR-64-200; AD-610663)

An experimental study has been made of the effect of a favorable pressure gradient on the Reynolds analogy factor, $K = 2ST/C_f$, for a natural two-dimensional supersonic turbulent boundary layer in air. Integrated values of the skin friction coefficient and Stanton number have been determined from experimental data. The results show that Colburn's value of $K = Pr^{-2/3}$, which was found empirically from zero pressure gradient data, is satisfactory for relating skin friction and heat transfer for the magnitudes of pressure gradients investigated. Author

N65-18692# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences
LINEARIZED, OSCILLATING, SUPERCAVITATING FLOW AT NONZERO CAVITATION NUMBERS
Wen-Hwa Chu Dec. 1964 56 p refs
(Contract NObs-90344)
(TR-1; AD-610338)

Parkin's theory of fully cavitated flow at nonzero cavitation numbers is modified and linearized. The modification lies in a corrected closure condition, taking into account the leading edge and cavity-end singularities. The linearized lift and moment expressions are derived for correlation with planned experiments which consist of measurements of the spanwise lift and moment distributions followed by flutter tests. Author

N65-18750# Therm Advanced Research, Inc., Ithaca, N. Y.
ON THE THEORY OF THE LOW-ASPECT-RATIO JET-FLAP HYDROFOIL
J. C. Erickson, Jr. and G. R. Hough Oct. 1964 57 p refs
(Contract Nonr-4275(00))
(TAR-TR-6405; AD-609729)

The equation for the lifting problem of a finite-aspect-ratio, thin, jet-flap hydrofoil in unbounded flow is considered and certain of its important properties are derived. Previous approximate and analog solutions of this equation are then briefly reviewed. An analytical approach to the low-aspect-ratio case is initiated by applying the well-known Jones approximation to a hydrofoil with jet flap. A solution is obtained and the results are compared with analog solutions and existing limiting cases. Deficiencies of this approximation are immediately apparent, especially for a deflected jet (singular blowing) and a rectangular planform. As a result, the improved

low-aspect-ratio theory of H. R. Lawrence is extended to include a jet flap. The corresponding equation is derived and its behavior is investigated with respect to the important properties of the exact equation. A tentative procedure for solving this equation is advanced and discussed. Author

N65-18798# Heliodyne Corp., Los Angeles, Calif.
RE-ENTRY PHYSICS RESEARCH Semiannual Technical Summary Report, 12 Jun.–31 Dec. 1964
Andrew P. Proudian et al Dec. 1964 17 p
(Contract DA-04-495-AMC-458(Z); ARPA Order 360; Proj. Defender)
(AD-609736)

This report describes reentry physics research. Investigations were conducted in the following areas: mixing and chemical reactions in turbulent wakes; stability of two-dimensional and axisymmetric laminar wakes; the influence of nonadiabatic collisions in the vibrational and dissociative relaxation of a high temperature gas; analyses of optical scintillation data from reentry field tests; and shock tube investigations of the spectroscopic and electromagnetic properties of ablation product–air mixtures. The individual research topics are presented as abstracts from completed reports, or progress reports on continuing activities. Author

N65-18955# Library of Congress, Washington, D. C. Aerospace Technology Div.
MIXING OF CONCENTRIC HIGH-VELOCITY AIRSTREAMS Compilation of Abstracts, Jan. 1962–Jun. 1963
3 Mar. 1965 13 p refs
(ATD-P-65-7)

Abstracts of articles from Soviet open literature during the period from January 1962 through June 1963 are given. R.L.K.

N65-18965# General Electric Co., King of Prussia, Pa. Space Sciences Lab.
DISTORTED WAVE CALCULATION OF ROTATIONAL EXCITATION OF N_2 BY SLOW ELECTRONS
R. C. Mjolsness and D. H. Sampson Nov. 1964 12 p refs
(Contract Nonr-4188(00))
(R64SD78; AD-609837)

Rotational excitation is usually an important energy loss mechanism for low energy electrons in a slightly ionized gas and can be very significant in determining its electrical properties. For N_2, which is probably of greatest practical interest, there have existed some uncertainties in the value for the rotational cross section and some discrepancies between theory and experiment. This note shows that these difficulties can be resolved. Author

N65-19007# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
CHOICE OF AN APPROPRIATE MEAN ABSORPTION COEFFICIENT FOR USE IN THE GENERAL GREY GAS EQUATIONS
D. H. Sampson Nov. 1964 35 p refs
(Contract Nonr-4188(00))
(R64SD77; AD-609838)

An approximate method for conveniently treating radiative transport in the intermediate regime in which a gas is neither optically thin nor optically thick is described. The method consists of using the general grey gas equations with the mean absorption coefficient chosen to be a function of optical thickness such that it decreases monotonically with increase in optical depth from the Planck mean absorption coefficient K_P when the gas is very optically thin to the Rosseland mean absorption coefficient K_R when the gas is very optically thick. Numerical results for the flux and the divergence of the flux obtained by this approximate method are compared with those obtained by an exact treatment for various optical thicknesses assuming free–free absorption and a linear temperature gradient. In this case where the frequency dependence of the absorption coefficient is strong enough that $K_P = 30\ K_R$, the results by our approximate method are nearly always within a factor of 2 of the correct values. Author

N65-19035# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHODS OF ACCELERATING A GAS FLOW TO HYPERSONIC VELOCITIES WITH THE AID OF A JET NOZZLE
M. D. Ladyzhenskiy 28 Jan. 1965 5 p Transl. into ENGLISH from Russian Patent no. 153153 (Appl. no. 758767/25-8, 10 Jan. 1962) p 1–2
(FTD-TT-64-871/1+2; AD-611050)

Jet nozzles are proposed to obtain hypersonic gas flow velocities in the range of small Reynolds numbers through enlargement of the through section of the nozzle behind its initial section. This construction leads to a sharply expanded gas flow, and thus reduces the harmful effects of the boundary layer. G.G.

N65-19053# Naval Ordnance Test Station, China Lake, Calif. Underwater Ordnance Dept.
A TURBULENT BOUNDARY-LAYER CALCULATION METHOD BASED ON THE LAW OF THE WALL AND THE LAW OF THE WAKE
D. M. Nelson Nov. 1964 48 p refs
(NAVWEPS-8510; NOTS-TP-3493; AD-609989)

A method for calculating the incompressible turbulent boundary layer based on the "law of the wall" and Coles' "law of the wake" is presented. The method is applicable to two-dimensional bodies and to bodies of revolution in axisymmetric flow when the boundary-layer thickness is not necessarily small compared to the body radius. The carrying out of this method involves a simultaneous solution of the momentum integral equation and the energy integral equation, assuming that the mean velocity profiles are given by a universal two-parameter representation as suggested by Coles. Since these two-parameter mean velocity profiles inherently contain sufficient information to determine the shear stress at the wall and the rate of energy dissipation in the boundary layer, and accurately represent velocity profiles to the point of separation, it is anticipated that there will result an improved technique for estimating the growth of a turbulent boundary layer which may be valid to the point of separation. Author

N65-19054# California Univ., Riverside. Dept. of Physics
THE ELECTRICAL PROPERTIES OF SEMIPERMEABLE MEMBRANES Annual Summary Report, Jan. 1–Dec. 31, 1964
L. J. Bruner (1964) 37 p refs
(Contract Nonr-4443(00))
(AD-609316)

A kinetic analysis of membrane conductance under conditions of stationary flow is presented. The semipermeable membrane is idealized as a homogeneous laminar phase separating ionic solutions on either side. It is assumed, without consideration of the mechanisms involved, that some ion species permeate the membrane while others do not. The flux of a given species is taken to be linearly related to the gradient

of its concentration and to the electric field. The resulting flow equations, when combined with Poisson's equation, permit the formulation of the conductance problem in terms of a set of nonlinear differential equations. They describe the spatial variation of the electric displacement and contain the ion current densities as parameters. Their integration, subject to appropriate boundary conditions, fixes the values of these parameters and of the corresponding transmembrane potential. The solution of the conductance problem cannot, however, be carried through in analytic form. The numerical analysis of a number of special cases will be presented in subsequent publications. Author

N65-19063# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.

AN INVESTIGATION OF HYPERSONIC FLOW SEPARATION AND CONTROL CHARACTERISTICS

Louis G. Kaufman, II, Lawrence Meckler, Stavros A. Hartofilis, and Daniel Weiss Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Jan. 1965 125 p refs

(Contract AF 33(616)-8130)

(AFFDL-TR-174; AD-611272)

Hypersonic flow separation and its effects on control characteristics were investigated analytically and experimentally. Included are conclusions drawn from extensive test data for hypersonic flows over basic geometries and over typical flight configurations with aerodynamic controls. The basic flow geometries discussed include: separation on flat plates ahead of ramps (flaps); flows over sharp expansion corners; breakaway separation; and fin plate interactions. Force data and limited pressure- and heating-rate distributions are presented for the flight configurations for various trailing-edge flap settings. As a supplement to this work, available sources of pertinent hypersonic controls data are tabulated. Author

N65-19081# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

VELOCITY AND TEMPERATURE DISTRIBUTION IN A TURBULENT BOUNDARY LAYER ON A PLATE

I. I. Zhyugzhda, V. I. Makaryavichyus et al 28 Jan. 1965 10 p refs Transl. into ENGLISH from Tr. Akad. Nauk. Lit. SSR., Ser. B: Khim, Geol. i Tekhn. Nauki (Vilna), no. 3, 1963 p 99–105

(FTD-TT-64-800/1+2; AD-611073)

Velocity and temperature distribution in a turbulent boundary layer of a heated and cooled plate in a channel with constant, and decreasing streams of transformer oil and water were determined. The temperature field was determined, using a small scale thermocouple placed in a coordinate mechanism, simultaneously with the velocity field. It is concluded that in case of heating in a layer near a wall, the velocities become greater than in an isothermal case and depend upon the temperature, pressure, and type of liquid. In the case of cooling in a layer near a wall, the velocities decrease. R.W.H.

N65-19091# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.

NON-NEWTONIAN PIPE FRICTION STUDIES WITH VARIOUS DILUTE POLYMER WATER SOLUTIONS Project Report No. 71

John F. Ripken and Meir Pilch Jun. 1964 64 p refs

(Contract Nonr-710(49))

(AD-610512)

This study extends existing data on the frictional drag reducing influence of long-chain polymers in dilute water solutions. Studies were conducted with both fresh and sea water in capillary tubes and pipes with a size range of 100 diameters and covering the laminar, transition, and turbulent regimes with N'_{Re} up to 8×10^5. Fifteen types of test additives were used, including Polyhall, Polyox, Westco Guar, and fish slime. Test temperatures ranged from 40° to 85° F. Dilute solutions ranging down to 10 ppM concentration exhibited remarkable friction reductions at high shear rates as a near-laminar type of flow. Data correlation was hampered by diameter, temperature, and concentration effects not resolved by existing flow parameters based on power law theory. Shear degradation effects were evaluated. Author

N65-19106# Princeton Univ., N. J. Dept. of Aerospace and Mechanical Sciences

SOME EXPERIMENTS ON EQUILIBRIUM TURBULENT BOUNDARY LAYERS IN FAVORABLE PRESSURE GRADIENTS

H. J. Herring and J. F. Norbury Nov. 1963 26 p refs

(Contract Nonr-1858(38))

(FLD-15; AD-601276)

A boundary layer wind tunnel in which an arbitrary negative pressure gradient could be developed was designed and built. The effects of selected pressure gradients on boundary layers grown on one of the walls of the tunnel were studied. It was possible to obtain equilibrium boundary layers of the type whose nondimensional velocity defect distribution is invariant along the direction of flow. The velocity defect distributions for two such boundary layers were established, corresponding to values of β of -0.35 and -0.53, where β is the nondimensional pressure gradient parameter. These velocity profiles are compared with the profiles predicted by the Mellor–Gibson theory (1963). The agreement between the two is very good. Author

N65-19110# Brown Univ., Providence, R. I. Div. of Engineering

THE INFLUENCE OF VISCOSITY ON SHOCK WAVES STRUCTURED BY RADIATION

Ira M. Cohen and Joseph H. Clarke Oct. 1964 19 p refs

(Contract Nonr-562(35))

(AD-609106)

The structure of normal shock waves with radiation, viscosity, and thermal conductivity is treated in the physically relevant limit of large radiation absorption length compared to molecular transport length. If radiation is not too intense or the shock too weak, then a viscous, conducting shock is found embedded in a radiation structured inviscid shock. Under very general conditions, this viscous shock within a shock has precisely the same structure as a classical (radiationless) viscous, conducting shock when reinterpreted as to initial and final states, to lowest order in an expansion based on the ratio of the two transport lengths. This lowest order solution is no longer trivial when the optically thin region considered is embedded in a much thicker region. The next order corresponds to the usual optically thin case but the well-known formula accounting for emission but not absorption by the gas does not apply, since the relative importance of these two effects changes markedly through the inner viscous shock. Author

N65-19114# Webb Inst. of Naval Architecture, Glen Cove, N. Y.

EXPERIMENTAL DETERMINATION OF SHIP WAVE RESISTANCE FROM THE WAVE PATTERN

Lawrence W. Ward Nov. 1964 78 p refs

(Contract Nonr-4152(00))

(AD-609083)

Ship wave resistance is defined and a survey of past and present efforts to determine this from a survey of the model wave pattern during a model test is given. A new method is developed using the continuous record of the x and y components of the lateral force exerted on a long fixed vertical circular cylinder by the model wave system after passage of the model. The paper includes theoretical analysis, a description of the technique and equipment necessary, and results of experiments which are compared to other experimental results, indicating that the method is a practical means of determining wave resistance in an ordinary ship model tank. Author

N65-19135# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYTIC INVESTIGATION OF TURBULENT FLAT JET, DEVELOPING IN A CO-STREAM
E. Timma 23 Nov. 1964 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk Eston. SSR, Ser. Fiz.-Mat. i Tekhn. Nauk (Tallinn), no. 1, 1963 p 57–74
(FTD-TT-64-359/1+2; AD-609150)

Analytic formulas were developed for the determination of the characteristics of the initial, basic, and transitional sectors of a turbulent plane-parallel jet in concomitant flow. Simple formulas for the axial speed are given. The length of the initial sector of the turbulent plane jet and the value of the turbulence constant depend substantially on the form of the universal function of the velocity field. E.E.B.

N65-19144# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CHANNELED BODIES STREAMLINED WITH FLAT AND CONIC SHOCK WAVES
V. V. Keldysh 18 Nov. 1964 8 p refs Transl. into ENGLISH from Inzh. Zh. (USSR), v. 4, no. 3, 1964 p 539–542
(FTD-TT-64-1189/1+2+4)

Solutions for external flow around channeled bodies with supersonic velocities in excess of Mach 6 at the inlet to the internal channel were considered. Two types of bodies were investigated: (1) bodies consisting of flat faces and streamlined over the design regime with the formation of flat, attached shock waves, and (2) axisymmetric bodies for which external flow is conical. The investigation of the latter was carried out on a computer using precise formulas for conical flow. Investigation of the former was performed using the results of Maykapar and Keldysh. E.E.B.

N65-19186# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATION OF THE PRESSURE-HEAD CHARACTERISTICS OF AXIAL HELICAL IMPELLERS
V. I. Dumov 11 Jun. 1963 19 p refs Transl. into ENGLISH from Teploenerg. (Moscow), v. 11, 1962 p 23–27
(FTD-TT-63-407/1+2+4; AD-413663)

A method of calculating the pressure-head characteristics of helical impellers is given, permitting determination of the pressure head and the rate of flow from a chosen configuration of the impeller. The results of experimental investigations to ascertain the dependence of the hydraulic losses on the fundamental geometrical and regime parameters of the impeller are reported. Author

N65-19193# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SHOCK WAVES
A. S. Kompaneyets 12 Jan. 1965 102 p refs Transl. into ENGLISH of the book "Udarnyye Volny" Moscow, Gos. Izd. Fiz.-Mat. Lit., 1963 p 1–92
(FTD-MT-64-232; AD-611041)

The subject of shock waves is discussed in detail with treatments of gas dynamics, actions of shock waves, and detonations being presented in turn. Sound waves, conditions of shock-wave discontinuity, compression, and the shock-wave-front structure are included. Supersonic waves, explosions, reflection, and shock waves in solid and friable bodies are discussed. The treatise concludes with consideration of detonation, including nuclear detonations and the resultant shock waves from these detonations. E.E.B.

N65-19269*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPERIMENTALLY MEASURED EFFECTS OF THE WALL BOUNDARY LAYER ON SHOCK-TUBE PERFORMANCE
F. R. Livingston 1 Mar. 1965 21 p refs
(Contract NAS7-100)
(NASA-CR-57266; JPL-TR-32-714) CFSTI: HC $1.00/MF $0.50

Shock speed and test time were measured in a 3-in. shock tube which is being evaluated as the hot gas supply for a 43-in. shock tunnel. Nitrogen was used as the test gas in the experiment, with hydrogen as the driver gas. Shock speeds compare favorably with the ideal shock-tube theory, corrected for laminar and turbulent wall-boundary-layer effects. Measured test time is shown to agree with the laminar wall-boundary-layer theory of Mirels at initial nitrogen pressures below 10 mm Hg. Test times approach the turbulent wall-boundary-layer estimate of Mirels at an initial pressure of 100 mm Hg. Author

N65-19274*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
TRANSIENT PRESSURE RESPONSE IN A FLUID SYSTEM AS A VIBRATING VALVE CLOSES
Cecil A. Ponder, Jr. 5 Feb. 1965 58 p refs
(NASA-TM-X-53206) CFSTI: HC $3.00/MF $0.50

Equations are derived that describe the unsteady flow in a pipeline when a vibrating valve closes; a pressure oscillation occurs in addition to water hammer. The results of analytical and experimental investigations show that the pressure oscillation causes an increase in the maximum transient pressure during valve closure that is proportional to the frequency and amplitude of valve vibration. Because the boundary conditions and natural frequencies may vary, each fluid system must be investigated to determine the relationships between the pressure oscillation and the frequency and amplitude of the valve vibration. The analytical methods reported can be used for such an investigation. Author

N65-19277*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THEORETICAL BOUNDARIES AND INTERNAL CHARACTERISTICS OF EXHAUST PLUMES FROM THREE DIFFERENT SUPERSONIC NOZZLES
Earl H. Andrews, Jr., Allen R. Vick, and Charlotte B. Craidon Washington, NASA, Mar. 1965 82 p refs
(NASA-TN-D-2650) CFSTI: HC $3.00/MF $0.75

Theoretical exhaust-plume calculations for nozzles exhausting into quiescent air were performed to obtain exhaust-plume boundaries and internal characteristics within rocket exhaust plumes. The calculations were performed for three

different supersonic nozzles over a range of ratios of nozzle-exit pressure to ambient pressure from approximately 10 to 10^6. Also included is a general study of exhaust-plume effects on a typical spacecraft which suggests several possible problem areas requiring further considerations. The results from the theoretical calculations give exhaust-plume contours out to the maximum plume diameter and the internal characteristics within the plumes for the three different nozzles. The internal characteristics of the exhaust plumes include Mach number, density, and temperature, which are presented in the form of plume internal contour mappings. Author

N65-19287# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THEORETICAL AND EXPERIMENTAL STUDIES OF IMPINGING UNIFORM AND NONUNIFORM JETS
W. Gordon Brady and Gary R. Ludwig Ft. Eustis, Va., Army Transportation Res. Command, Aug. 1964 102 p refs
(Contract DA-44-177-AMC-18(T))
(CAL-TG-1818-S-1; TRECOM-TR-64-42)

The jet velocity profile was representative of rotors and ducted fans. Emphasis was on determining the properties of the flow near the ground. Some measurements of the flow in the turning region of the jet are presented, along with flow visualization pictures. The jet was tested at distances from the ground of 4-, 2-, and 1/2-nozzle diameters. An approximate analysis which uses an empirical relation for radial mass flow near the ground is used to calculate the properties of the flow along the ground at radii large enough so that the pressure gradient is approximately zero. A method of calculating the properties of the flow in an inviscid, normally impinging, uniform jet has been formulated; the formulation is applicable for all distances between the jet nozzle and the ground. Solutions were obtained for jets at nozzle-to-ground distances of 1/4- and 1-jet diameters. Author

N65-19305# von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
OPTIMIZATION OF RECOVERY TRAJECTORIES FOR SPACE VEHICLES Final Scientific Report
L. Moulin 30 Sep. 1964 32 p refs
(Grant AF-EOAR-63-39)
(AFOSR-64-2481; AD-609573)

This report shows that optimum recovery conditions must be defined as those which minimize an overall deadweight which must include the fuel for eventual rocket braking outside the atmosphere, and the mass which is ablated for heat protection into the atmosphere. The results indicate that when chemical or nuclear propulsion is considered, pure atmospheric braking will always be the best solution, but when electrical propulsion is used, an optimum compromise between partial rocket and atmospheric braking may exist, depending upon the respective properties of propulsion system and ablating material. Author

N65-19345# Aeronautical Research Labs., Melbourne (Australia).
THE INTERACTION OF AN OBLIQUE SHOCK WAVE WITH AN EXPANSION FAN
C. H. Ellen (Sydney Univ.) Jan. 1964 21 p refs
(ARL/A-225)

The accuracy of approximate solution of the oblique shock-expansion fan interaction is examined by comparison of two limiting cases. In the first case the interactions of the shock wave with reflections from the entropy gradient is ignored. In the second case all the wave interactions are taken into account in an asymptotic solution. Results from these cases are compared, and differences in final shock wave angle are found to be only appreciable when large entropy gradients are produced in the flow. The change in strength in the shock wave is calculated and the results show an increase in shock strength through the expansion for all cases, except when the Mach number is small and the shock near detachment. Author

N65-19372# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
HYDRODYNAMIC FLOW EQUATIONS WITH A PLASTICITY RESISTANCE LAW
J. K. Dienes 8 Dec. 1964 11 p refs
(Contract DA-04-495-AMC-116(X); ARPA Order 71-62)
(GAMD-5910; AD-610677)

Equations of state, motion, plastic flow, axially symmetric, and spherically symmetric flows have been assembled using tensor notation. Also, stress and strain tensors written as the sum of a hydrostatic part and a deviator part, and the total strain rate written as the sum of a hydrostatic part and a deviator part, and the total strain rate written as the sum of an elastic and plastic part are presented. E.E.B.

N65-19374# California Univ., Los Angeles. Aerosonics Lab.
FLUID MOTION AND SOUND Annual Summary Report, May 1, 1963–Oct. 30, 1964
Alan Powell Dec. 1964 12 p refs
(Contract Nonr-233(62))
(Rept.-64-61; AD-610716)

A collection of abstracts pertaining to fluid motion and sound is presented in this summary. Recent developments in aerodynamically generated sound, control of jet flow, generation of sound by heat, and structural excitation by sound are discussed. G.G.

N65-19428# Space Technology Labs., Inc., Redondo Beach, Calif.
PRELIMINARY STUDY OF THE VISCOUS INVISCID INTERACTION IN THE LAMINAR SUPERSONIC NEAR WAKE
W. H. Webb, R. J. Golik, and Lester Lees Jul. 1964 44 p refs
(Contract AF 04(694)-440)
(STL-6453-6004-KU-000; BSD-TDR-64-114; AD-610858)

A solution of the two-dimensional boundary layer equations using a two-moment integral method is examined. Simple polynomial profiles are used, permitting an analytical study of important features of the problem. In particular, the determinant of the system of differential equations is evaluated and the location of singularities of the solution is found. The local inviscid flow angle (hence the pressure) is determined by finding the solution which passes through the Crocco–Lees critical point for a given free-stream Reynolds and Mach number. Several sample calculations of base flow are given which enable an evaluation of the Chapman model of instantaneous recompression. Also, a comparison is made with the earlier solution of Lees and Reeves for the adiabatic case in which Stewartson profiles were used. Despite the simplicity of the present analysis, good agreement is found for axis velocity ratios greater than −0.1; it is therefore concluded that the solution is not sensitive to assumed profile shape near and beyond the stagnation point. Author

N65-19460# AVCO-Everett Research Lab., Everett, Mass.
ENTROPY BOUNDARY LAYERS
S. Weinbaum Jan. 1965 14 p refs Sponsored in part under subcontract by Bell Telephone Labs.
(Contracts DA-30-069-ORD-1955; AF 04(694)-414)
(AVCO-Everett Res. Rept.-207; BSD-TDR-64-165; AD-611126)

Crocco's equation for the entropy gradients in an inviscid compressible flow is extended to flows with viscosity and conductivity using the boundary-layer equations of motion. The general structure of the entropy boundary layer is discussed, and entropy profiles are presented for the $Pr = 1$ boundary layer using cold, hot, and adiabatic wall conditions at several representative subsonic and supersonic Mach numbers. For an adiabatic wall the entropy profile has an inverse boundary-layer structure in velocity coordinates, the greatest variation occurring near the outer edge of the boundary layer as $u/u_\infty \rightarrow 1.0$, while the entropy near the wall is essentially constant. For cold wall conditions total enthalpy gradients and vorticity have opposing effects, and the entropy profile can have a maximum provided M_∞ exceeds a minimum critical value. Entropy is a convenient state variable with which to express the variation of vorticity and total enthalpy in a supersonic boundary layer prior to a rapid expansion or separation and can be used to describe these two phenomena in much the same manner that entropy is presently used to describe the flow behind a curved shock wave. Author

N65-19467# France. Ministere de l'Air, Paris.
CONTRIBUTION TO THE STUDY OF LIQUID JET DISPERSION AT A HIGH SPEED [CONTRIBUTION A L'ETUDE DE LA DISPERSION DES JETS LIQUIDES A GRANDE VITESSE]
J. Dodu Serv. de Doc. Sci. et Tech. de l'Armement, 1964 96 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 407

The dispersion of high velocity liquid jets in still air is characterized by a numerical value calculated from statistical sampling of photographs taken at very high shutter speeds. The study of the influence of the fluid properties (viscosity, surface tension) on the dispersion reveals, for rapid jets with low dispersion, a significant effect of surface tension.
Transl. by M.P.G.

N65-19470# California Univ., Los Angeles.
THREE-DIMENSIONAL VISCOUS VORTICES IN INCOMPRESSIBLE FLOW
William Stephen Lewellen (Ph.D Thesis) Ann Arbor, Mich., Univ. Microfilms, 1964 168 p refs

An understanding of axially symmetric swirling flows is pursued by examining solutions of the incompressible Navier–Stokes equations. Primary interest is on vortex flows driven by a radial convection of angular momentum. Exact solutions are considered with the aid of similarity transformations available for the reduction of the partial differential equations of motion to ordinary differential equations. Nearly exact solutions are obtained by linearizing about known flows, both nonswirling flows and strongly rotating flows, and by expanding the equations of motion in terms of a basic flow parameter, the ratio of radial volume flow to circulation. The complete nonlinear problem of driven vortex flow in a cylindrical container is solved. Author

N65-19479# Royal Aircraft Establishment, Farnborough (England).
THE STABILISATION OF DETONATION WAVES BY MEANS OF BLUFF BODIES [O STABILIZATSII DETONATSIONNYKH VOLN PRI POMOSHCHI PLOKHOOBTEKAEMYKH TEL]
M. P. Samozvantsev Jan. 1965 11 p refs Transl. into ENGLISH from Prikl. Mekhan. i Tekhn. Fiz. (USSR), no. 4, 1964 p 126–129
(RAE-LIB-TRANS-1088)

The flow of a combustible mixture past a bluff body is analyzed taking into account the ignition delay, so that a flame front is formed some distance downstream of the bow shock. From a study of the results of an experiment on a sphere in a ballistic range, approximate criteria for the existence of a Chapman–Jouguet detonation wave are established. Author

N65-19512*# National Aeronautics and Space Administration, Washington, D. C.
CONDITIONS FOR SIMILITUDE IN THE CASE OF SLENDER BODIES WITH A HYPERSONIC TURBULENT BOUNDARY LAYER [OB USLOVIYAKH PODOBIYA DLYA GIPERZVUKOVOGO TURBULENTNOGO PROGRANICHNOGO SLOYA NA TONKIKH TELAKH]
V. V. Lunev Mar. 1965 11 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1962 p 13–17
(NASA-TT-F-9297) CFSTI: HC $1.00/MF $0.50

The conditions for similitude in hypersonic flow past flat ($\nu = 0$) and axisymmetric ($\nu = 1$) slender blunt bodies with a turbulent boundary layer on the surface are investigated, assuming variable entropy at the outer edge of the layer. The case of a laminar boundary layer was treated previously, and without regard for the influence of variable entropy by Cheng. Author

N65-19573# Texas Univ., Austin. Hydraulic Engineering Lab.
SEPARATION IN A NON-UNIFORM SHEAR FLOW
Charles Dalton and Frank D. Masch Sep. 1964 27 p refs (Contract Nonr-375(16))
(HYD-04-6402; AD-609778)

This report presents work done to investigate the effects of a nonuniform flow field on the angle of separation for flow about a circular cylinder. Experimental data show that the angle of separation is relatively small in regions where the free-stream velocity is high, and relatively large in regions where the free-stream velocity is low. The angle at which separation occurred on a circular cylinder was found to vary from 70° to 101°. Data were collected for a Reynolds number range of 10^4 to 10^5. Author

N65-19578# Naval Ordnance Lab., White Oak, Md.
A STUDY OF THE WATER-ENTRY CAVITY
Albert May and William R. Hoover Mar. 1965 72 p refs
(Ballistics Res. Rept. 121; NOLTR-63-264; AD-611406)

For missiles producing clean cavities after water entry the cavity development is shown by theory to depend significantly only on entry angle, an effective mass, and a Froude number based on the nose-flat diameter. A method is outlined for estimating pressures in closed, almost steady cavities, from cavity geometry. Author

N65-19579# General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
RE-ENTRY PHYSICS RESEARCH Final Report, Nov. 1963–Nov. 1964
Nov. 1964 123 p refs
(Contract DA-04-495-ORD-3383(Z); ARPA Order 393-63, Proj. Defender)
(GDA-DBE-64-064; AD-455155)

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3. SHOCK TUBE PROGRAM SUMMARY K. G. P. Sulzmann p 94–117 refs

N65-19702*# McGill Univ., Montreal (Quebec). Space Research Inst.

A FINITE DIFFERENCE SOLUTION FOR THE CYLINDRICAL EXPANSION OF A GAS CLOUD INTO VACUUM

I. Shanfield, J. H. S. Lee, and G. G. Bach 15 Mar. 1965 111 p refs

(Contract NAS3-4190)

(NASA-CR-54254) CFSTI: HC $4.00/MF $0.75

A finite difference method for the solution of an axisymmetric expansion of a perfect gas into vacuum is developed. The method is applied to the expansion of a gas with an equation of state of the form of Tillotson's equation. The solution obtained by the finite difference method for a perfect gas expansion is checked by comparison to the characteristic solution. A similarity solution for the perfect gas expansion is compared to the long-term finite difference solution. Author

N65-19710*# Ling-Temco-Vought, Inc., Dallas, Tex. Research Center

EFFECTS OF SOLVENT PURITY ON NON-NEWTONIAN VISCOSITY

W. D. Ernst Jan. 1965 8 p

(Contract NASw-729)

(Rept.-0-71000/5R-2)

Experimental determination of viscosity in non-Newtonian fluids is reported. Fluid samples were tested in water with various polymer additives, and shear stress was measured as a function of shear rate. The measurements were used to calculate the constants in the power law used to describe fluid properties. Results showed that non-Newtonian fluids produced from dilute concentrations of polymers have a temperature dependence unlike that of Newtonian fluids, and that the effect of the additive is to alter the normal dependence of the viscosity of water on temperature. J.M.D.

N65-19832# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.

FLOW VISUALIZATION: A COMPARISON OF STREAMING BIREFRINGENCE WITH OTHER TECHNIQUES

D. H. White Mar. 1965 85 p refs

(Contracts AT(45-1)-1350; AT(45-1)-1830)

(BNWL-31) CFSTI: $3.00

The flow visualization technique known as streaming birefringence (SBR) was studied by direct comparison with three other techniques; small spherical plastic tracers, cotton thread surface tufts, and dye injection. Comparative tests on four differently shaped, two-dimensional models were run. Reynolds numbers for the incompressible fluids varied from about 1000 to about 6000. These tests showed that an SBR solution of bentonite clay compared favorably with other visualization techniques for the flow separation around a cylinder, flow separation at the throat of a restrictor, vena contracta of an orifice, and transverse flow in a rectangular channel. The SBR fluid compares unfavorably or questionably for diffuser separation and circular eddies. It is concluded that the SBR flow visualization technique has potential for use as a visualization tool, requires skill and care in use, and should be investigated in greater depth. Author

N65-19852*# Case Inst. of Tech., Cleveland, Ohio. Plasma Research

AN ANALYSIS OF CONFINED VORTEX FLOWS

David E. Loper (M.S. Thesis) Jun. 1964 67 p refs

(Grant NsG-198)

(NASA-CR-57401; TR-A-31) CFSTI: HC $3.00/MF $0.75

The vortex flow of an incompressible fluid between two finite flat plates is considered. Special attention is given to the case for which the radius of the plates is larger than their separation distance. A momentum integral solution gives the variation of the important parameters β, the modified boundary layer thickness, and g_1, the radial velocity, with the radius for various values of A, a measure of the imposed radial mass flow. Author

N65-19945# Iowa State Univ. of Science and Technology, Ames. Ames Lab.

TRANSIT TIMES AND ELECTRICAL DISCHARGE IN A STEADY-STATE GAS ACTIVATION SYSTEM

David Thomas and Willard L. Talbert Nov. 1964 72 p refs

(Contract W-7405-ENG-82)

(IS-1012) CFSTI: $3.00

The problem of transporting a gas from the core of a reactor to the ion source of an electromagnetic isotope separator in a steady-state fashion is studied. The parameters on which this flow depends are ascertained so that the flow may be predictably controlled by a computer. The transit time through the activation line is calculated and confirmed experimentally for nitrogen and xenon. The initiation of an electrical discharge in the low-pressure gas by a 60-kV potential is studied as a function of the gas and the gradient length. Author

N65-19969# ARO, Inc., Arnold Air Force Station, Tenn.

MIXING AND BURNING OF BOUNDED COAXIAL STREAMS

C. E. Peters, T. Peters, and R. B. Billings Arnold Eng. Develop. Center, Mar. 1965 52 p refs

(Contract AF 40(600)-1000)

(AEDC-TR-65-4; AD-458348)

An experimental and theoretical investigation of bounded turbulent mixing with chemical reactions is described. Configurations applicable to the air-augmented rocket are considered. Experimental results are presented for a mixing apparatus in which a fuel-rich O_2–H_2 rocket stream was mixed with a secondary airstream inside a conical duct. An integral mixing theory is described, in which conservation equations are satisfied across the duct. The inviscid portions of the duct flow are considered one-dimensional, and the mixing zone profiles are assumed to exhibit shape similarity. The theory is extended to include the downstream regime where the mixing region extends across the entire duct. Correlations of the theory with incompressible and reactive compressible mixing experiments indicate that the theory provides a satisfactory overall representation of the bounded mixing process. Author

N65-19982# Princeton Univ., N. J. Gas Dynamics Lab.

HYPERSONIC FLOW OVER A WEDGE WITH UPSTREAM NON-UNIFORMITIES AND VARIABLE WEDGE ANGLE

A. R. George Dec. 1964 149 p refs *Its* Rept.-695

(Contract AF 49(638)-1271; Grants AF-AFOSR-112-63; AF-AFOSR-112-63A)

(AFOSR-65-0002; AD-612286)

This paper analyzes the supersonic and hypersonic flow over a wedge in a parallel nonuniform free stream. The free-stream property or velocity gradients are assumed to be small and in the spanwise direction. The substitution principle allows transformation of a general nonuniform parallel free stream into one with constant velocity. In both the supersonic and hypersonic cases a perturbation analysis is used giving linear

theories. For low and moderate supersonic Mach numbers a double power series expansion of the potential in wedge angle and upstream Mach number discontinuity is used. Terms up to second order are solved for in order to obtain the interaction effects. This potential analysis indicates an equivalence between a variation in Mach number and a variation in wedge angle. For hypersonic flows the perturbations of a strong shock, slender wedge flow due to either a free-stream property or wedge angle discontinuity are obtained. Author

N65-19988# David Taylor Model Basin, Washington, D. C. Aerodynamics Lab.
DRAG RESULTING FROM SEPARATED FLOW INDUCED BY SURFACE CAVITIES AT A MACH NUMBER OF 3.74
Bertram K. Ellis and Howard S. Ryan, Jr. Nov. 1964 17 p refs
(DTMB-AL-9; AD-458229)

Drag tests on several two-dimensional cavities were conducted at Mach 3.74. These cavities, which spanned the test section, were essentially circular grooves of fixed diameter imbedded at various depths in a flat-plate surface. The results reveal that the drag due to these cavities is considerably greater than theoretical flat-plate skin friction drag. Of the several configurations tested, the one with the cavity depth equal to its radius gave the maximum drag, with values nearly three times that of a theoretical flat plate. Author

N65-19998# David Taylor Model Basin, Washington, D. C. Applied Mathematics Lab.
TABLES OF THE GOLDSTEIN FACTOR
C. L. Tibery and J. W. Wrench, Jr. Dec. 1964 71 p refs
(DTMB-1534; AD-261744)

The tables of the Goldstein factor presented in this report were computed on the IBM 7090. They were computed for the purpose of supplying more extensive and reliable information than that available in similar tables of Goldstein, Lock and Yeatman, Kramer, Tachmindji and Milam, and the second of the present authors. These tables are applicable to the calculation of the distribution of the circulation along lightly loaded, optimum propellers for which the number of blades ranges from 2 to 10, inclusive. The Goldstein factor determines the effect of a finite number of propeller blades on the circulation, and simultaneously relates the maximum value of the tangential velocity component induced at a lifting line with its circumferential average. The emphasis on an increased number of blades, as reflected in these more extensive tables, arises from the need to alleviate the loading or cavitation problems associated with the increased power of modern ships. Author

N65-20010# Geoscience, Inc., Cambridge, Mass.
DEEP RESISTIVITY RESULTS FROM NORTH CAROLINA, VIRGINIA, PENNSYLVANIA, WISCONSIN, AND MISSOURI Scientific Report No. 5
Howard Lahman and Philip Nelson Dec. 1964 102 p refs
(Contract AF 19(628)-2351)
(AFCRL-65-9; AD-612609)

Surface resistivity measurements of Precambrian igneous and metamorphic rocks reveal that high resistivities are not to be found in North Carolina, Pennsylvania, or in the vicinity of Farmville, Virginia, or Merrill, Wisconsin. The Merrill traverse may not be representative of Continental Shield exposures, however. Near Bedford, Virginia, some high values were obtained, but actual resistivity over 10^5 ohm-meters is not probable. The St. Francois Mountains of Missouri yield high values suitable for layered interpretation, but interpretation complications due to the small size of the area do not permit distinction between two- and three-layer models. In Missouri a minimum second-layer resistivity of 20000 ohm-meters is established, but the maximum cannot be established at present. The data allow a high resistivity layer. To a depth of at least 1 kilometer, in all areas covered, the data reflected the mapped lateral geologic and structural variations and indicated, in some cases, additional complications. Author

N65-20035*# Toronto Univ. (Ontario). Inst. for Aerospace Studies
AN EXPERIMENTAL INVESTIGATION INTO THE SHAPE OF THRUST-AUGMENTING SURFACES IN CONJUNCTION WITH COANDA-DEFLECTED JET SHEETS, PART I
Ft. Eustis, Va., Army Transportation Res. Command, Dec. 1964 109p refs
(Grant DA-TC-44-177-G1)
(UTIA-TN-70; TRECOM-TB-64-23; AD-611759)

The flow from a two-dimensional subsonic nozzle was deflected by quadrants. A composite thrust-augmenting surface was added, and the effect of its shape on thrust augmentation was studied at various nozzle pressure ratios and radii of the quadrants. This investigation yielded a maximum thrust augmentation of 1.21 for several optimum configurations, which was governed primarily by the relative magnitude and direction of the momentum of the secondary (entrained) flow in relation to the primary (nozzle) flow momentum. Thrust augmentation decreased with increasing nozzle pressure ratio but was independent of the quadrant radius. Some of the observed results were predicted theoretically. Suggestions for possibly introducing higher thrust augmentation are offered. Author

N65-20040# Princeton Univ., N. J. Gas Dynamics Lab.
INCOMPRESSIBLE CAVITY FLOWS IN TWO DIMENSIONS AT LOW REYNOLDS NUMBER
Henrik J. Hagerup Jun. 1964 39 p refs /*ts* Rept.-691
(Contract AF 49(638)-1271)
(AFOSR-65-0058; AD-430675)

Linearized solutions for simple shear flow past wave-shaped walls are superposed to yield recirculatory flow patterns for a series of shallow cavities with slope discontinuities at the ends. Author

N65-20058# Minnesota Univ., Minneapolis. St. Anthony Falls Hydraulic Lab.
CAVITY FORMATION AND ASSOCIATED DRAG IN A SUPERCAVITATING FLOW OVER WEDGES IN A BOUNDARY LAYER Project Report No. 69
H. G. Stefan and A. G. Anderson Apr. 1964 91 p refs
(Contract Nonr-710(43))
(AD-448490)

Supercavitating flow over wedges (half-wedges) attached to a solid boundary can be simulated by air injection in the wake of the wedges. Information on cavity formation behind single wedges in a boundary layer—specifically, cavity length, air demand, and pressure distribution inside and outside the cavity as a function of wedge characteristics (height and angle), stream velocity, and blockage effect—was obtained by experiment. Drag on such single artificially supercavitating wedges was measured. Experiments were carried out in a conduit of rectangular cross section with the wedges attached to the bottom. The ultimate purpose of the investigation was to examine whether a cavity generated on a flat plate has a skin friction reducing effect and how such a cavity can be generated most efficiently by a wedge without introducing important supplementary drag. Author

N65-20064# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Mechanics
STUDY OF FLOW INDUCED IN VISCOELASTIC LIQUID BY A ROTATING CONE
W. H. Hoppmann, II and C. N. Baronet Oct. 1964 22 p refs
(Contract Nonr-591(20))
(AD-606798)

To determine the proper equations for the motion induced in a viscoelastic liquid by a rotating cone, an extensive series of photographs of lines of flow were obtained. The liquid studied was polyisobutylene dissolved in cetane. The flow visualization was obtained by means of a dye which was injected into the liquid in a systematic manner. The photographic study was made for cones of vertex angles 110° and 160°. Some visual observations were also made in the case of a cone of vertex angle 176°. Measurements of both torque and thrust were made on each of the three cones at various angular velocities. Sketches of the types of flow lines are presented, along with curves showing interesting results for thrust and torque as functions of angular velocity. The higher concentrations show well defined maxima at definite angular velocities. Peculiarities of the flow are discussed, and some suggestions for an analytical description of the velocity fields are presented Author

N65-20075# National Bureau of Standards, Boulder, Colo.
ON THE FORMULATION AND NUMERICAL EVALUATION OF A SET OF TWO-PHASE FLOW EQUATIONS MODELLING THE COOLDOWN PROCESS
Stephen Jarvis, Jr. 4 Jan. 1965 52 p refs
(NBS-TN-301) GPO: $0.55

A model of transient two-phase flow in a pipe is constructed in Eulerian coordinates assuming a single velocity but independent temperatures in the two phases. Experiments on the numerical integration of the system for Cooldown problem by both Lax and Courant–Isaacson–Rees methods indicate that a very fine spatial difference net must be used to compensate for the numerical diffusion essential to computational stability if a second surge is to be realized. Author

N65-20084# Centre de Recherches et d'Essais de Chatou (France). Département de Mécanique des Fluides
CONTRIBUTION TO THE STUDY OF CHARGE LOSSES AND VELOCITY PROFILES IN MAGNETOHYDRODYNAMIC TURBULENT FLOW [CONTRIBUTION A L'ETUDE DES PERTES DE CHARGE ET PROFILS DE VITESSE EN ECOULEMENT TURBULENT EN MAGNETOHYDRODYNAMIQUE]
Pierre Lococq Oct. 1964 186 p refs In FRENCH Suppl. to *Its* Bull. No. 8

Turbulence and magnetohydrodynamic studies have established that fluctuations of the magnetic field consecutive to the turbulence are negligible when a magnetic field is superimposed during the experiment. This technique was used to study the evolution and energy of turbulence with the following results: (1) definition of a criterion concerning the turbulent–laminar transition related to charge losses in MHD flows in quadratic sections; (2) presentation of velocity profiles and distributions in plane flow, showing that the magnetic field tends to flatten the velocity profile in the central part of the flow in such a way that profiles parallel to the lines of force are flatter than those perpendicular to the lines of force, and showing that boundary layers in the vicinity of walls parallel to the lines of force are thicker than those near walls perpendicular to the lines of force; and (3) development of a method to determine velocity distribution from the graduated potential of the electric field in the middle of the flow. M.P.G.

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N65-18661# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
DAILY SUMS OF GLOBAL RADIATION FOR CLOUDLESS SKIES
S. J. Bolsenga Nov. 1964 129 p refs
(CRREL-Res. Rept.-160; AD-610552)

Quantitative information on global radiation for studies pertaining to the distribution, accretion, and ablation of ice and snow, thawing of soils, evaporation, and climatology is given in tables containing radiation received on a horizontal surface under cloudless skies. Sums of global radiation were computed as a function of geographic latitude, declination of the sun, precipitable water content of the atmosphere, and atmospheric dust attenuation to the solar beam. Expressions are given for determining (1) daily sums of extraterrrestrial solar radiation, (2) daily solar radiation at the surface of the earth, (3) atmospheric transmission as a function of the optical air-mass, (4) the effect of dust attenuation on solar energy, (5) daily sums of direct solar radiation at the surface of the earth, and (6) total precipitable water vapor content of the atmosphere. Author

N65-18662# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
GLACIER SLIDING
J. Weertman (Northwestern Technol. Inst.) Nov. 1964 19 p refs
(CRREL-RR-162; AD-610553)

The theory of the sliding of glaciers has been generalized (1) by taking into account the resistance to sliding offered by obstacles both smaller and larger than the controlling obstacles, and (2) by relaxing the assumption that ice is always in intimate contact with the bed at the downstream side of an obstacle. The sliding velocities and controlling obstacle sizes which are found from the generalized theory are approximately the same as those found from the earlier theory. A new result obtained from the present theory is the fact that a water layer an order of magnitude smaller in thickness than the height of the controlling obstacles can cause an appreciable increase in the sliding velocity. The generalized theory contains Liboutry's sliding theory as an extreme limiting case. For certain thicknesses of a glacier the sliding velocity is a double-valued function of the shear stress exerted at the bed. Author

N65-18681# Boston Univ., Mass.
STUDY OF THE EARTH'S IONOSPHERE BY RECEPTION OF RADIO WAVES FROM SATELLITES Scientific Report No. 1
Sunanda Basu (M.S. Thesis-1963) Oct. 1964 73 p refs *Its* Astron. Contrib. Ser. II, No. 37
(Contract AF 19(628)-2350)
(AFCRL-64-831; AD-611093)

A study of ionospheric scintillations by the reception of signals from the Russian satellite 1962 Cosmos I was undertaken. The data were obtained at the Sagamore Hill Radio Observatory, Hamilton, Massachusetts. The satellite transmitted at a frequency of 20 Mc/s and it was found possible to receive the first two harmonics at 40 Mc/s and 60 Mc/s. A high percentage of scintillation was observed on all nighttime transits

of the satellite. No marked variation of scintillation index with elevation angle was observed. The scintillation index varied with wavelength as $\lambda^{0.78}$ for magnetically quiet days and as $\lambda^{0.36}$ for magnetically disturbed days. A pronounced latitude dependence of scintillations was observed. The onset of scintillations occurred at a subionospheric latitude (referred to a height of 300 km) of 35° N on magnetically quiet days, and the same effect was observed at 33° N for magnetically disturbed days. A zone of almost uniform scintillation exists beyond a latitude of 41° N. Author

N65-18733 Joint Publications Research Service, Washington, D. C.
IMPROVEMENT OF THE PROPERTIES OF ACID OPEN HEARTH STEEL BY THE USE OF RARE EARTH METALS
Yu. V. Kryakovskiy, Yu. I. Rubenchik, V. N. Lebedev, L. I. Nedosekin, P. T. Chumakov et al *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 250–263 refs (See N65-18701 09-17) CFSTI: $7.00

On the basis of a preliminary investigation of the influence of additions of rare-earth metals (REM) on the quality of acid open hearth steel, the following were established: When REM are introduced into the ingot in amounts of 0.50–1.5 kg/ton, the macrostructure of steels 34KhNMA and 40KhGS is somewhat improved. However, when 1.0 kg of REM per ton is introduced into an ingot of steel 40KhGS, specific macroflaws are detected in the upper surface portions of the forging. The addition of 0.67–0.85 kg of REM per ton leads to an increase in the plasticity characteristics and impact ductility on transverse samples of steel 34KhNMA, both at room temperature (20°), and especially at increased (350°) and reduced (−40°) temperatures. The level of the strength characteristics is practically unchanged by the addition of REM. Author

N65-18805* National Aeronautics and Space Administration, Washington, D. C.
THE IQSY AND THE SPACE ROCKET—OBSERVATIONS DURING THE IQSY
Kengich Maeda *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 61–69 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Separate projects and equipment are described for the International Quiet Sun Year (IQSY). The description is a report of the conference in Rome, in March 1963, preceding the IQSY. Project areas include earth atmosphere composition, weather parameters, temperature, and geomagnetism. J.M.D.

N65-18843* National Aeronautics and Space Administration, Washington, D. C.
IONOSPHERE DIRECT-OBSERVATION DEVICES AND THE OBSERVATION RESULTS
Kunio Teshiri *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 294–305 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Later models of the ionosphere direct-observation device used on the K-9 space rocket are discussed, mainly the changes. The new elements under development are the electron-energy-distribution measuring device, mass analysis device, and ionospheric electrical field measuring device. In conclusion, it is expected that the improved devices will be used on a longer flight and on an earth satellite observing the activity of the ionosphere. R.W.H.

N65-18846* National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF THE ATMOSPHERIC LIGHT LAYER BY MEANS OF A ROCKET
M. Furuhata, M. Nakamura, T. Nakamura, and J. Nakamura *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 324–328 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa-8-5 and Kappa-8-9 rockets contain two light-collecting cylinders and their own photon tubes and amplifiers. Knowing that the head of the rocket faced upward while proceeding to the point of highest altitude, the data obtained for the oxygen green line and the sodium D line were analyzed to determine the altitude corresponding to the highest line intensity. R.W.H.

N65-18847* National Aeronautics and Space Administration, Washington, D. C.
RESULTS OF THE OBSERVATION OF TEMPERATURE AND WIND IN THE UPPER ATMOSPHERE Report No. 2
K. Maeda, Y. Takeya, H. Matsumoto, T. Okumoto, H. Ohya, and W. Tatebe *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 329–333 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The temperature distribution in the range up to 45 km, recorded by rocket TW-10, is almost the same as that recorded by TW-8, and had the appearance of the so-called summer-type recorded at Guam and White Sands. The wind test results obtained by TW-10 prove to be of the summer type because of the strong east wind in the middle layer of the air. R.W.H.

N65-18849* National Aeronautics and Space Administration, Washington, D. C.
WIND-TUNNEL EXPERIMENT OF IONOSPHERE PROBE—PROBE MEASUREMENT IN DRIFTING PLASMA
Toshihiko Tsuchida, Torao Ichimiya, and Fusao Kamaki *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 344–349 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

In order to create a plasma in the wind tunnel, a copper ring 20 mm in width and 86 mm in diameter, was placed in front of a Laval nozzle and applied high voltage using the nozzle as the negative pole and the ring as the positive pole. The probe, a sphere of 5-mm diameter made from stainless steel, was placed in between the poles. The probe was moved in five steps (20 mm/step), from the point 47 mm forward of the negative pole. Probe measurements were obtained and the positive ion density N+ was calculated by the analytical method of the probe characteristics in a drift plasma. The electron density Ne was calculated from the characteristics of the electron current. R.W.H.

N65-18862# Navy Electronics Lab., San Diego, Calif. Radio Physics Section
MODEL STUDIES OF THE NIGHTTIME IONOSPHERIC D REGION FROM POLARIZATION MEASUREMENTS MADE AT THE GROUND Research and Development Report, Jan.–Jul. 1964
E. E. Gossard 6 Nov. 1964 64 p refs
(NEL-1249; AD-456418)

It is concluded that nighttime fluctuation in the phase and amplitude observed on short, vlf radio paths is typically due to interference between two or more reflected waves. Several hypothetical models were investigated to determine their effect on the polarization of the downcoming skywave.

A fairly simple two-layer model seems capable of explaining the observed variability in the polarization data. Other models containing only one layer in the D and E regions appear unable to account for the observations. Author

N65-18874# Stanford Univ., Calif. Radioscience Lab.
ASSOCIATION BETWEEN VLF EMISSIONS AND FLICKERING AURORA Technical Report No. 3412-4
Eigil Ungstrup Jun. 1964 7 p refs
(Grant AF-AFOSR-62-370)
(SEL-64-050; AD-610854)

Very low frequency signals were recorded in Fairbanks, Alaska for 16 nights between September and October 1963 and an unusual chorus-type of sound emission was heard on 4 occasions. The bursts of emission were associated with active periods in the aurora, when there was a rayed band (a_3R_2B4b) with a red lower border and brightness 3 or 4 through its zenith. The active periods, during which vlf emission bursts occurred, lasted a couple of seconds, and alternated with quiescent periods of a few seconds. The spectra of the chorus-type of emission are presented, together with the vlf burst data on magnetically disturbed nights. G.G.

N65-18927*# National Aeronautics and Space Administration, Washington, D. C.
IQSY SOLAR ECLIPSE, SCIENTIFIC EXPEDITION
19 Mar. 1965 32 p Information kit containing AFCRL, AFOSR, AEC, DASA, NAS-NRC, NASA (News Release-65-36), NBS, NSF, NOTS, and ONR News Releases

The IQSY scientific program to observe the May 30, 1965 total eclipse of the sun in the South Pacific area is outlined. Several agencies will participate in these observations which will include (1) direct photography of the extended outer atmosphere of the sun or corona; (2) spectroscopic and polarimetric observations of the light emitted by the corona; (3) layer-by-layer analysis of the structure of the solar chromosphere or lower atmosphere, and (4) studies of the response high in our own atmosphere to an interruption of sunlight. Various other observations will be made from ground stations as well as from airborne vehicles. G.G.

N65-18932* Israel Program for Scientific Translations, Ltd., Jerusalem.
GASEOUS COMPOSITION OF THE ATMOSPHERE AND ITS ANALYSIS
B. A. Mirtov 1964 215 p refs Transl. into ENGLISH of the book "Gazovyi Sostav Atmosfery Zemli i Metody Ego Analiza" Moscow, Izd. Akad. Nauk. SSSR, 1961
(NASA-TT-F-145; OTS-64-11023) CFSTI: HC $6.00/MF $1.25

The gaseous compositions of the lower, middle, and upper atmospheres were investigated by means of balloon ascents, sounding rockets, and artificial satellites. Also, the ionic composition of the upper atmosphere was determined using radio-frequency spectrometry from artificial satellites. Concentration of ozone in the atmosphere is also discussed. E.E.B.

N65-18950# Alaska Univ., College. Geophysical Institute
COMMENTS ON WAVE FORMS IN NOCTILUCENT CLOUDS
B. Haurwitz Dec. 1964 43 p refs
(Grant NSF GP-1759)
(UAG-R160)

Quantitative discussions of the waveforms in noctilucent clouds are offered in the expectation that they may assist in the formulation of future observation programs, and in the interpretation of observations as they become available. The most important requirement for further study of the dynamics of the wave motions in noctilucent clouds is information about the wind and temperature distributions. Such data would permit an unambiguous explanation of the observed waveforms. These wave motions are of interest not only in connection with the study of noctilucent clouds, but also for the interpretation of ionospheric data, for the study of turbulence in the high atmosphere, and in general for the understanding of the dynamics of the high atmosphere. E.E.B.

N65-19002# Stanford Univ., Calif. Radioscience Lab.
SOME TECHNIQUES FOR MEASURING AND RECORDING DOPPLER SHIFTS FROM DRIFTING METEOR TRAILS Scientific Report No. 1
Robert Nowak Nov. 1964 31 p refs
(Contract AF 19(628)-3996)
(SEL-64-121; AFCRL-64-1016; AD-611363)

Several methods of measuring and analyzing Doppler shifts produced by moving meteor trails (from which windspeeds at E-region heights can be deduced) are presented. Emphasis is placed on obtaining the data so that they can be reduced easily and quickly and measurements can be made and evaluated on a routine basis. Using one of the described systems, several thousand data points were obtained during an 18-day period; their evaluation led to results very similar to those obtained elsewhere. Author

N65-19023# New England Univ., Armidale (Australia).
IONIZATION GROWTH AT SUNRISE IN THE E-F REGION OF THE IONOSPHERE Scientific Report No. 2
C. S. G. K. Setty, R. A. Smith, and I. A. Bourne 24 Jun. 1964 55 p refs
(Contract AF 19(604)-6177; DASA-WEB-04-054)
(AFCRL-64-516; AD-609979)

Ionograms were recorded at frequent intervals near sunrise using a Cossor ionosonde with an aerial array of 40 dipoles for 1.515 Mc/s, the gyrofrequency in the lower E-region. The sensitivity was high enough to record extraordinary reflections from the F-layer down to 1.7 Mc/s. Well before ground sunrise the group heights of the extraordinary reflections near 2 Mc/s increase rapidly and this effect is followed by the appearance of up to three stratifications below the F-layer. Sunrise photoionization in a model atmosphere having a linear scale height gradient between the E- and F-layers was computed for the ultraviolet radiations (911–1027 Å) and X-rays (10–170 Å), which produce their maximum photoionization during the day at the peak of E-layer. The ionization below 200 km before ground sunrise produced by these spectral ranges is large enough to explain the increases in group height of the extraordinary reflections and to account for many features of the stratifications. Author

N65-19051# Pennsylvania State Univ., University Park Ionosphere Research Lab.
THE MEASUREMENT OF PHASE AND AMPLITUDE RADIO WAVE INTERACTION AT UNIVERSITY PARK, PENNSYLVANIA, FOR JULY–AUGUST–SEPTEMBER, 1964
Anthony J. Ferraro and Hai Sup Lee 20 Jan. 1965 68 p refs /*ts* Sci. Rept.-232
(Contract AF 19(628)-4014; Grant NSF GP-846)
(AFCRL-64-992; AD-610221)

The measurement of phase and amplitude radio wave interaction, to be carried out during the International Quiet Solar Year (IQSY) is described. The interaction parameters, T_A and T_ϕ, are given as a function of height for the dates and times indicated. These will be utilized to determine N, ν, T_e and G as functions of height and time for D- and lower E-region during the IQSY. Author

N65-19069# Oslo Univ., Blindern (Norway).
VARIATIONS IN ENERGY SPECTRUM OF AURORAL ELECTRONS DETECTED BY SIMULTANEOUS OBSERVATION WITH PHOTOMETER AND RIOMETER Scientific Report No. 8
O. E. Johansen [1964] 25 p refs
(Contract AF 61(052)-680)
(AFCRL-65-59; AD-611326)

Because auroral luminosity and auroral absorption are produced mainly by electrons with different energy, simultaneous observation with photometer and riometer can give information about the energy spectrum of the incident electrons, and can be used to detect variations in this spectrum. Limited to cases with homogeneous auroral forms covering most of the sky, observations at λ5577 Å and 27.6 MHz show that the energy spectrum can remain constant for long periods, from half an hour to several hours and whole nights. Large and rapid variations do occur, but less frequent than would be expected from satellite observations. This indicates that many variations in electron energy spectrum observed by satellite-borne instruments are variations in space rather than variations in time. An average over three winters shows a diurnal variation in the energy spectrum with a hardening in the spectral shape between 20 and 01 local time. An unexpected high and variable light intensity corresponding to zero riometer absorption is also discussed. Author

N65-19088# Oslo Univ., Blindern (Norway). Inst. of Physics
CURRENT DENSITIES IN VISUAL AURORAS Scientific Report No. 7
A. Omholt and H. Lorentsen [1964] 20 p refs
(Contract AF 61(052)-680)
(AFCRL-65-58; AD-611324)

The magnetic perturbations associated with quiet auroral forms with a fairly simple geometry (auroral arcs, broad bands and glow) were studied, using the magnetic records from stations in and near the auroral zone. The north–south spacing between the stations was 60 to 80 kms. From the height distribution of auroral luminosity and the other parameters involved, the Pedersen and Hall conductivities were computed as functions of height during the aurora. From these curves it is seen that the vertical thickness of the conducting layer is about 25 km, regardless of whether Hall or Pedersen currents are the dominating. It is deduced that in all the auroral forms the current densities must be a few times 10^{-9} A/cm^2 and the electric field of the order of magnitude 10^{-3} V/cm. It is not possible from such observations to determine the direction of the electric field, nor whether vertical currents exist in the form of vertical current sheets. Author

N65-19126# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ATTEMPTED EXPLANATIONS OF BALL LIGHTNING
Edmond M. Dewan Nov. 1964 27 p refs *Its* Physical Sci. Res. Papers No. 67
(AFCRL-64-927; AD-608969)

Ball lightning has until this time defied physical explanation. This report summarizes the requirements that must be satisfied by any valid theory, reviews and evaluates previous theories, and evaluates the new theory of Finkelstein and Rubenstein. It is concluded that the latter theory is the only promising one to date but that even this theory needs to be modified. A modification is proposed which would remove the remaining objections and it is suggested that experiments, rather than further theoretical development, will constitute the next decisive step. Author

N65-19160# Army Electronics Labs., Fort Monmouth, N. J. Inst. for Exploratory Research
DETERMINATION OF THE IONOSPHERIC ELECTRON CONTENT UTILIZING SATELLITE SIGNALS
P. R. Arendt, A. Papayoanou, and H. Soicher Nov. 1964 33 p refs
(ECOM-2515; AD-610110)

The total subsatellite content is obtained by measurements of the satellite itself (active method obtaining and integrating profiles from topside sounding) or through observations at the ground of satellite cw transmissions (passive methods using Doppler or Faraday effect, or both simultaneously). Differential methods are bound to the existence of identical ray-path geometry for the frequencies observed simultaneously. This path identity is checked by precise calculation of the Doppler inflection time moments. This calculation is based on many (more than 100) single-frequency measurements made during the center interval of each passage. The topside-sounder profile data, combined with appropriate bottomside data, yield complete electron-density profiles that, when integrated, can be compared with electron-content data from passive methods. However, a direct comparison is possible only when active and passive observations can be made simultaneously. Author

N65-19291# Hawaii Univ., Honolulu. Hawaii Inst. of Geophysics
SOME SELECTED STUDIES OF THE ATMOSPHERIC BOUNDARY LAYER Final Report, Nov. 1960–Aug. 1964
Wan-Cheng Chiu and Mariano A. Estoque Sep. 1964 34 p refs
(Contract AF 19(604)-7484)
(HIG-64-19; AFCRL-64-887; AD-610949)

In the lowest layers of the atmosphere, the wind, temperature, and moisture fields are greatly influenced by the characteristics of the underlying earth's surface. Attempts were made to develop certain types of numerical models of the lowest layers of the atmosphere. The results of the studies of the sea breeze phenomenon, the wind and temperature fields, and the upward flux of heat with these models are summarized. Author

N65-19310# California Univ., San Diego. Marine Physical Lab.
MANIPULATORS AND SPECIAL DEVICES
Victor C. Anderson and H. A. O'Neal (ONR) 31 Jul. 1964 15 p refs
(Contract Nonr-2216(05); Proj. Seabed)
(SIO-REF.-64-16; MPL-U-50/64; AD-609490)

The important factors involved in the performance of work in the deep ocean are discussed, and the requirements for special devices which may be used to enhance the efficiency of this work are outlined. The basic requirements of observations and manipulation point to specific needs for technological developments but do not call for any extensive program of fundamental research. Author

N65-19319# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A LARGE APERTURE SEISMIC ARRAY
P. E. Green, Jr. 6 Jan. 1965 25 p refs *Its* Group Rept.-1965-1
(AD-609851)

This experimental system is designed to provide improved capability for seismic discrimination of nuclear explosions and earthquakes. This improvement is to be brought about by suppression of reverberation and microseismic noise relative to the signal, through the use of a larger number of sensors and a larger array aperture than previously used in the seismic

arrays. A brief report is given of the way in which the signal improvement is to be achieved, followed by a physical description of the entire array design as it is currently envisioned, including the choice of sensors, array geometry, signal telemetry, and signal processing. Author

N65-19343# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
FALLOUT OF RADIOACTIVE DEBRIS FOLLOWING NUCLEAR EXPLOSIONS [SULLE RICADUTE RADIOATTIVE CONSEGUENTI ALLE ESPLOSIONI NUCLEARI]
G. de Florio 14 Nov. 1964 40 p refs In ITALIAN; ENGLISH summary
(ISS-64/38)

A brief description of the methods of collection and examination of radioactive fallout particles and a summary of formation processes are given. Radiochemical composition of debris is also discussed in connection with the fractionation processes. Author

N65-19347# Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA Data Summary 64/1, Jan.–Mar. 1964
W. Riedler, ed. [1964] 66 p

Geophysical data related to polar upper atmosphere conditions are presented for January to March, 1964. The data include geomagnetic K-indices, ionosphere absorption, oblique vhf auroral reflections, vlf radio-wave propagation, satellite recordings, visible auroral index, earth currents, and magnetic pulsations. M.P.G.

N65-19348# Kiruna Geophysical Observatory (Sweden).
KIRUNA GEOPHYSICAL DATA Data Summary 64/2, Apr.–Jun. 1964
W. Riedler, ed. [1964] 52 p

Geomagnetic K-indices, ionospheric absorption, oblique vhf auroral reflections, vlf radio wave propagation, satellite recordings visible auroral index, micropulsations, and earth currents are summarized for April to June 1964, as measured at Kiruna Geophysical Observatory, Kiruna C, Sweden. E.E.B.

N65-19357# Stanford Research Inst., Menlo Park, Calif.
ANALYSIS OF DAYTIME RADIATION DATA FROM TIROS IV Scientific Report No. 4
William Viezee and Paul A. Davis Dec. 1964 37 p refs
(Contract AF 19(628)-2777)
(AFCRL-64-905; AD-609767)

A sample of winter time data from the solar channels of Tiros IV over the eastern Pacific is examined to determine the dependence of the albedo on the anisotropy of scattered and reflected solar radiation. The analysis shows a significant increase in cloud albedo when the scattering angle decreases between 90 and 53 degrees. Data collected from the two solar channels of Tiros IV reveal a compatibility superior to that of similar data from the early orbits of Tiros III. Synoptic-scale cloud patterns shown in the photographs from Tiros IV are identified in the pattern analyses of coincident radiation data from Channels 2, 3, and 5. Data from the solar channels from three separate orbits, over backgrounds with varying cloudiness, are examined for degradation in instrumental response. Except possibly for the first few orbits, no physical interpretation can be attached to variations of the low-flux data from the solar channels. Author

N65-19425# Naval Oceanographic Office, Washington, D. C. Marine Surveys Div.
GRAVITY MEASUREMENTS OVER THE EUROPEAN CALIBRATION LINE WITH La COSTE AND ROMBERG GRAVITY METERS G-2, g-5, AND g-15
S. C. Ernberg and D. F. Hollensbe Oct. 1964 32 p refs
(TR-169; AD-611106) Available from Naval Oceanographic Office, Washington, D. C.: $0.70

Detailed gravity measurements were made over the European calibration line during the summer of 1963 using three LaCoste and Romberg gravity meters. The data revealed that all three meters were effected by nonlinearity and periodical response errors. Author

N65-19492# Cornell Univ., Ithaca, N. Y. Geology Dept.
GEOTHERMAL STEAM: ORIGIN, CHARACTERISTICS, OCCURRENCE, AND EXPLOITATION Final Report
George A. Kiersch 14 Nov. 1964 203 p refs
(Contract AF 19(628)-293)
(AFCRL-64-898; AD-611808)

Geothermal stream resources were explored in about 100 districts of over 15 countries throughout the world. Methods for investigating unknown regions are discussed as to the following: (1) geologic characteristics of geothermal districts; (2) volcanism; (3) physical factors of critical importance; and (4) field studies. Exploration data and features reviewed suggest volcanic conditions and a "magma" source of heat at depth. The geologic circumstances favorable to the location of geothermal fluids and a field are outlined. All available sources of exploration data, direct and indirect, are combined to suggest the potential for geothermal resources. The utilization of geothermal energy and hot waters is described. A review of additional geothermal data is given. A bibliography of 575 titles covers information on geothermal areas and resources and the hot spring areas throughout the world. Author

N65-19496# Oslo Univ., Blindern (Norway). Norwegian Inst. of Cosmic Physics
STUDIES OF LOCAL MORPHOLOGY, STRUCTURE AND DYNAMICS OF AURORA Final Report, 1 Mar. 1963–30 Nov. 1964
A. Omholt, ed. [1964] 29 p refs
(Contract AF 61(052)-680)
(AFCRL-65-60; AD-611325)

Summaries of the special scientific reports published as a result of auroral studies in Norway are presented, followed by reports giving the main purpose and the results to date of other studies still in progress. Auroral topics covered include theory, interferometry, H_α doppler profile, VLF emission, current densities, electron energy spectrum, excitation of N_2 and N_2^+ bands, movement of auroral rays, temperature measurements from N_2^+ bands and A10 vibrational levels, spectrophotometric investigation of nightglow and aurora, and design and operation of a four-channel photometer. M.P.G.

N65-19507*# National Aeronautics and Space Administration, Washington, D. C.
THE RATE OF FORMATION OF RADIOACTIVE ISOTOPES IN CHONDRITES UNDER THE ACTION OF COSMIC RAYS [SKOROST' OBRAZOVANIYA RADIOAKTIVNYKH IZOTOPOV V KHONDRITAKH POD DEYSTVIYEM KOSMICHESKIKH LUCHEY]
A. K. Lavrukhina, R. I. Kuznetsova, and L. M. Satarova Mar. 1965 18 p Transl. into ENGLISH from Geokhimiya (Moscow) no. 12, 1964 p 1219–1227
(NASA-TT-F-9283) CFSTI: HC $1.00/MF $0.50

For investigating the rate of formation of radioisotopes in chondrites under the influence of cosmic rays, aluminum nuclei bombarded by protons of 120–660 MeV were used, since the mass number and atomic weight of aluminum correspond to their weighted average for chondrites. Semiempirical formulas are given for the cross section for formation of cosmogenic isotopes, which agree with experimental values at a proton energy of 660 MeV. Maximum formation rates are calculated for the center of chondrites of 10-cm radius, relative to their average chemical composition. The rate of formation of cosmogenic isotopes depends on the size and chemical composition of the meteorite, and on their spatial distribution in the meteorites. Comparative experimental and calculated values are tabulated for various targets, proton energies, and elements. Author

N65-19508*# National Aeronautics and Space Administration, Washington, D. C.
RADIOBERYLLIUM IN FOSSIL BONES [RADIOBERILLIY V ISKOPAYEMYKH KOSTYAKH]
V. V. Cherdyntsev, T. A. Ibrayev, and V. F. Mochalova Mar. 1965 8 p refs Transl. into ENGLISH from Geokhimiya Moscow), no. 12, 1964 p 1240–1243
(NASA-TT-F-9284) CFSTI: HC $1.00/MF $0.50

The hypothesis that fossil bones contain radioberyllium was verified on specimens from various regions of the U.S.S.R. by colorimetric determination with the morin process, coincidence scintillation measurements, and comparison with standards. The specific activity in fossil bones is higher than in other terrestrial objects, but its fluctuations make it impossible to determine the absolute age of fossil bones, specifically since the isotope was probably captured by the bone substance during the secondary mineralization. Author

N65-19513*# Consultants and Designers, Inc., Arlington, Va.
ESSENTIAL CHARACTERISTICS OF THE STRUCTURE OF "PEARL LIKE" FLUCTUATIONS OF THE MAGNETIC FIELD IN GEOMAGNETICALLY CONJUGATE REGIONS [CARACTERISTIQUES ESSENTIELLES DE LA STRUCTURE DES OSCILLATIONS EN PERLES DANS DES REGIONS GEOMAGNETIQUEMENT CONJUGUEES]
A. M. Borsukov and C. Poinsot 24 Mar. 1965 12 p refs Transl. into ENGLISH from Ann. Geophys. (Paris), v. 20, no. 4, 1964 p 473–479
(Contract NAS5-3760)
(NASA-TT-F-9657; ST-GM-10310) CFSTI: HC $1.00/MF $0.50

Numerical analysis was applied to the study of rapid fluctuations of the earth's magnetic field (pearls), and the correlation between the oscillations and between their envelopes. Preliminary results indicate the following: (1) Comparison of the two components, perpendicular to the same point, shows that the oscillations of different frequencies, composing the beatings, have elliptical polarizations, of which the major axes are different. (2) Study of the same components at two stations, distant by 1100 km, showed that the two phenomena are in phase. (3) When the same method is applied to registrations of two geomagnetically conjugate regions, it is impossible to find any inphase correlation between the two signals. (4) A complete similitude exists between the envelopes of received oscillations in two geomagnetically conjugate regions, the only difference being a certain time lag between the two maxima, approximately equal to the half-period of repetition. Author

N65-19574 United Electrodynamics, Inc., Pasadena, Calif.
INVESTIGATION OF SYSTEM RESPONSE AS A FUNCTION OF AZIMUTH FROM TONTO FOREST SEISMOLOGICAL OBSERVATORY Special Report No. 15
V. W. Taylor 14 Aug. 1964 10 p
(Contract AF 33(657)-7747; Proj. VETA)
(AD-609532)

The results of this limited study are inconclusive. Perhaps four of the twelve systems studied may be consistent in relative amplitude response to the explosive signals, sites Z-60, Z-64, Z-17, and Z-69. However, none of the displacements from teleseismic signals seems to indicate a consistent response. Likewise, the comparisons between teleseismic and explosive signals when grouped by quadrant do not show a definite pattern. Indications are that the study lacked sufficient data or perhaps the window of observations was too large. The nearby explosive signals show as much as 2.9:1 ratio of relative amplitude response at different seismometers. The teleseismic signals show only a maximum 1.7:1 ratio. Generally, seismometer Z-71 has a high relative response, and seismometers 31 and 73 are low. Author

N65-19651# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
SCALING DIMENSIONS OF CRATERS PRODUCED BY BURIED EXPLOSIONS
A. J. Chabai Feb. 1965 46 p refs
(SC-RR-65-70) CFSTI: $3.00

The question of the proper scaling of crater dimensions resulting from buried explosions is investigated. Dimensional analyses are performed from which four different scaling rules are derived. Data are reviewed in an attempt to distinguish which scaling rules are fundamental to cratering. Inability to perform cratering experiments with similitude apparently is one reason for lack of an unambiguous answer to the scaling question. Influences of possible sources of similarity violation are qualitatively examined, and some experiments are suggested which may provide more direct information about the correct scaling of crater dimensions. Author

N65-19688*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
THE REDUCTION OF IONOGRAMS FROM THE BOTTOMSIDE AND TOPSIDE Scientific Report No. 230
J. R. Doupnik and E. R. Schmerling 1 Jan. 1965 57 p refs (Grant NsG-134-61)
(NASA-CR-57289) CFSTI: HC $3.00/MF $0.50

A method is discussed for reducing ionograms to electron density height profiles on a modern digital computer by representation in terms of parabolic laminations. This provides good accuracy without an excessive number of scaled points. Since no precomputed coefficients are used, ionograms may be scaled at any frequency and from any location. It is shown how a least-squares joint ordinary and extraordinary analysis enable a correction to be made for underlying ionization, and reduce sensitivity to scaling errors. Special features of topside ionograms are discussed. Formulation in terms of segments parabolic in log (plasma frequency) is especially efficient in matching layer shape without discontinuity of slope. Techniques for incorporating the variation of gyrofrequency with altitude are discussed. It is emphasized that significant errors in the deduced electron scale height can be made if this is not done adequately. Author

N65-19705*# Consultants and Designers, Inc., Arlington, Va.
ON THE MECHANISM OF ELECTRICITY GENERATION IN THUNDERSTORMS [O MEKHANIZME GENERIROVANIYA GROZOVOGO ELEKTRICHESTVA]

V. D. Reshetov 22 Mar. 1965 22 p refs Review paper Transl. into ENGLISH from Russian Periodical
(Contract NAS5-3760)
(NASA-TT-F-9656; ST-AM-10307) CFSTI: HC $1.00/MF $0.50

Aerosol particle charging by selective adsorption of H^+ and OH^- ions as a function of pH and condensation or evaporation processes of aerosols is a basis for the generation mechanism of thunderstorm electricity. The violent condensation in powerful updrafts of a thundercloud leads to the generation in its lower half of a negative space charge at the expense of the preferential adsorption of ions OH^- on the surface of cloud drops. In the upper half of the cloud, formation of a positive charge takes place at the expense of preferential yield of ions OH^- from the surface of cloud particles. The energy for aerosol particle charging originates from adsorption and condensation heat. The power of thunderstorm electricity generation is found to be more substantial when the ascending currents are more intense and the height of their spread is greater; it is also related to the humidity and water content of the cloud.
R.W.H.

N65-19707*# Consultants and Designers, Inc., Arlington, Va.
RESONANCE OF THE EARTH IONOSPHERE CAVITY: DIFFERENCE BETWEEN THE DIURNAL VARIATIONS OF TWO ORTHOGONAL MAGNETIC COMPONENTS [RESONANCE DE LA CAVITE TERRE-IONOSPHERE: DIFFERENCE ENTRE LESS VARIATIONS DIURNES DES DEUX COMPOSANTES MAGNETIQUES ORTHOGONALES]
Jean Etcheto and Jacqueline Sterne 28 Mar. 1965 6 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 259, no. 10, 16 Nov. 1964 p 3584–3587
(Contract NAS5-3760)
(NASA-TT-F-9659; ST-RWP-AI-10311) CFSTI: HC $1.00/MF $0.50

A method of simultaneously measuring the variations of the East–West and North–South magnetic resonance amplitude of the earth's ionospheric cavity provides continuous registrations for 48 hours of the 2 components of the magnetic field, a reference signal at 8 cps, and hourly signals. Six week-long observations at a French observatory showed daily maxima for the N.–S.-components and the E.–W.-component at 0900 and 2200 hours u.t., and an additional E.–W.-maximum at about 1500 u.t. The E.–W.-components were of much lower intensities. Calculations of the average variations during 10 days of registration for the period from August 19 to August 29, 1964 are presented graphically.
G.G.

N65-19730# Washington Univ., Seattle. Dept. of Atmospheric Sciences
RADIATIVE ENERGY EXCHANGE OVER ARCTIC LAND AND SEA, PART I, DATA, 1962
John J. Kelly, Jr., Desmond T. Bailey, and Bruce J. Lieske Nov. 1964 209 p refs
(Contract Nonr-477(24))
(AD-609583)

Global shortwave, reflected shortwave over sea, reflected shortwave over land, net total over sea and net total land radiation were measured continuously. Kipp and Zonen solarimeters were used to measure the shortwave radiation, and Suomi ventilated radiometers to measure the net total radiation. Limitations and errors of these instruments are discussed. Hourly means of radiative flux density for each component are tabulated by day and month, and the daily energy sums are given. The data are believed to have an accuracy of ±6%.
Author

N65-19732*# Consultants and Designers, Inc., Arlington, Va.
MEASUREMENT OF THE RADIOACTIVITY INDUCED BY COSMIC RADIATION IN THE BOGOU METEORITE [MESURE DE LA RADIOACTIVITE INDUITE PAR LE RAYONNEMENT COSMIQUE DANS LA METEORITE DE BOGOU]
Daniel Nordemann and Jacques Tobailem 17 Mar. 1965 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. Meteorites (Paris), v. 259, 1964 p 3581–3583
(Contract NAS5-3760)
(ST-CC-10306; NASA-TT-F-9655) CFSTI: HC $1.00/MF $0.50

The activities of the gamma emitters in a 0.185-kg sample of the Bogou meteorite were measured by quantitative gamma spectrometry. The values obtained for Mn^{54}, Na^{22}, Co^{60}, Ti^{44}, and Al^{26} are tabulated; the Mn^{54}, Co^{60}, and Al^{26} values are in good general agreement with published data. A consideration of the principal modes of formation of these nuclides under the influence of cosmic radiation leads to the conclusion that the activity of Mn^{54} must be influenced by the original size of the meteorite and the relative position of the studied sample within it, whereas the Co^{60} activity is a function of the shape of the meteorite sample and of its position. Therefore, the production of Co^{60} at the center of a meteorite of the size of the Bogou meteorite is greater than at the edges.
M.P.G.

N65-19753*# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station
TURBULENCE IN THE UPPER ATMOSPHERE
C. G. Justus and H. D. Edwards Jul. 1964 56 p refs
(Grant NsG-304-63; Contract AF 19(628)-3305)
(NASA-CR-57258) CFSTI: HC $3.00/MF $0.50

Data indicate that turbulence observed up to altitudes near 105 km is ambient turbulence, produced by wind shears. This turbulence is isotropic only for scales ≈ 1 km or less. The smallest eddies are on the order of 20 m in size with characteristic velocities and times of about 2 m/sec and 10 sec. The largest eddies observed are about 6 km in size with characteristic velocities and times of about 15 m/sec and 400 sec. It is thought that tidal waves and gravity wave components may account for the major portion of all velocity fluctuations with size scales greater than 6 km. The turbopause, or upper height limit of turbulence of the scales observed, usually occurs within ±5 km of the 105-km level. This cutoff altitude appears to be the result of the rate of energy supplied by the wind shears becoming too small to maintain the turbulence in the presence of a dissipation rate which is increasing rapidly with altitude.
Author

N65-19756*# Illinois Univ., Urbana. Electrical Engineering Research Lab.
SCINTILLATION OBSERVATIONS OF SATELLITE SIGNALS
P. R. Kranz and K. C. Yeh Jan. 1965 33 p refs
(Grant NsG-24-59)
(NASA-CR-57219) CFSTI: HC $2.00/MF $0.50

Satellite scintillation data recorded during the decaying portion of the sunspot cycle shows a decrease in nighttime scintillation north of 40° latitude with a decrease in sunspot activity. Scintillation south of 40° latitude is observed to change little with sunspot activity. Diurnal, seasonal, and latitude variations of scintillation are studied, and comparisons are made between auroral and subauroral scintillation and also between radio star and satellite scintillation. Spread F and the latitude of transitions in scintillation are compared. This comparison suggests that the southern

boundary of the scintillation-producing region is not a smooth curve lying along a geomagnetic latitude line but is irregular in nature. A brief discussion is given of some probable causes of scintillation which are then compared with what is observed experimentally. Author

N65-19769*# Geophysics Corp. of America, Bedford, Mass.
LOW MESOPAUSE TEMPERATURES OVER EGLIN TEST RANGE DEDUCED FROM DENSITY DATA
R. A. Minzner, G. A. Faucher (AFCRL), and G. O. Sauermann
Jan. 1965 13 p refs
(Contract NASw-976)
(NASA-CR-57312; GCA-TR-65-1-N) CFSTI: HC $1.00/MF $0.50

Usually low values of temperature (about 156° ±16° K) were found to exist in the region of 100-km altitude over Eglin Gulf Test Range in Florida at 2315 hours GMT on December 7, 1961. These low temperatures were determined from 50 density–altitude data points over the altitude range of 97.8 km to 132.2 km, without the use of any independent temperature information. The basic density data and their associated uncertainties were deduced from measurements of drag accelerations on a falling sphere of 2.74-meters diameter. From the extent of the temperature uncertainty, it is apparent that the temperature–altitude profile is well bounded for altitudes below 110 km, especially for the lower two kilometers of the profile, and these low mesopause temperatures are therefore significant. Author

N65-19856*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
NEW DETERMINATION OF ZONAL HARMONICS COEFFICIENTS OF THE EARTH'S GRAVITATIONAL POTENTIAL Special Report No. 165
Yoshihide Kozai 2 Nov. 1964 42 p refs
(Grant NsG-87-60)
(NASA-CR-57443) CFSTI: HC $2.00/MF $0.50

From Baker–Nunn observations of nine satellites, whose inclinations cover a region between 28° and 95°, values were derived for the zonal harmonics coefficients of the earth's gravitational field. Author

N65-19857*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
STATIC DIFFUSION MODELS OF THE UPPER ATMOSPHERE WITH EMPIRICAL TEMPERATURE PROFILES Special Report No. 170
Luigi G. Jacchia 30 Dec. 1964 56 p refs
(Grant NsG-87-60)
(NASA-CR-57236) CFSTI: HC $3.00/MF $0.50

Tables of atmospheric density and composition are computed for a wide range of exospheric temperatures, starting from a fixed set of boundary conditions at 120 km. The diffusion equation is integrated following empirical temperature profiles of exponential form capable of reproducing the densities derived from satellite drag over the years. Formula are given which relate the exospheric temperature to solar and geomagnetic activity and allow for the diurnal and semi-annual variations. The different response of the density at the 200-km level to different types of heating is briefly discussed. Author

N65-19956# National Bureau of Standards, Boulder, Colo. Central Radio Propagation Lab.
COMPILATIONS OF SOLAR-GEOPHYSICAL DATA
Jan. 1965 42 p

This compilation of solar geophysical data includes information on daily solar indices, solar flux at 2800 Mc/s, calcium plage and sunspot regions, Mt. Wilson magnetic classifications of sunspots, provisional coronal line emission indices, solar radio emission interferometric and spectral observations, geomagnetic activity indices, and other observations for the period September to December 1964. G.G.

N65-19973# Atomics International, Canoga Park, Calif.
DETERMINATION OF NITROGEN AND OXYGEN ATOMS IN THE UPPER ATMOSPHERE Final Report
J. Greyson and R. T. Keen Bedford, Mass., AFCRL 1 Dec. 1964 37 p refs
(Contract AF 19(628)-4056)
(AI-65-27; AFCRL-64-990; AD-611551)

Freeze-dried polystyrene aerogels or fluffs, when reacted with gaseous atoms, yield stable, free radical products at concentration levels dependent upon the concentration of the reacting atoms. These reactions, as applied to oxygen and nitrogen atoms, were investigated for possible use in upper atmosphere sampling of atoms. Electron paramagnetic resonance spectroscopy was used for qualitative and quantitative product analysis. This preliminary investigation revealed that about 1% of the atoms passing through the fluff were captured. Measurements of lifetimes showed that about 1000 minutes were required for decay to half a starting product concentration. Such reaction efficiencies and product lifetimes are sufficient for upper atmosphere sampling and remote measurement. The reaction rates of both atom species with fluff are similar resulting in negligibly small interference from N atoms during oxygen atom measurements. Further experimental work on the reproducibility of the kinetic measurements is required. Author

N65-20015# Lowell Technological Inst. Research Foundation, Mass.
RESEARCH DIRECTED TOWARD THE STUDY BY AIRBORNE AND GROUND OBSERVATIONS OF AURORA AND AIRGLOW EMISSIONS UTILIZING PHOTOMETERS AND SPECTROMETERS Final Report
Henry A. Miranda, Jr., Robert J. Le Coz, and Robert E. Anctil
Dec. 1964 21 p refs
(Contract AF 19(628)-4031)
(AFCRL-64-1010; AD-612026)

The results of studies related to night airglow latitude dependence, South Atlantic anomaly, the Grainger–Ring effect, and the oyxgen line behavior studied with Fabry–Perot interferometers are reported and discussed. Modification of the aurora and airglow laboratory on the AFCRL (KC-135-3131) ionospheric physics aircraft is also described. Author

N65-20047# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
CRUSHING STRENGTH AND LONGITUDINAL WAVE VELOCITY IN PROCESSED SNOW
James L. Smith Jan. 1965 16 p refs
(CRREL-TR-137; AD-611749)

A series of crushing strength tests were conducted at Houghton, Michigan, on samples of processed snow in conjunction with a program of determining the longitudinal wave velocity during the process of aging at a controlled temperature

of −10° C. A relation between the longitudinal wave velocity and crushing strength at −10° C was established as

$$\sigma_c = \frac{C_1 - C_0}{a}$$

where σ_c is the crushing strength in psi, C_1 is the longitudinal wave velocity in ft/sec, and C_0 and a are constants, depending on the initial density of the test specimen. Author

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N65-18619# Martin Co., Baltimore, Md. Electronic Systems and Products Div.
STUDY AND INVESTIGATION OF MISSILE LIFTOFF MEASUREMENT SYSTEM Final Report, 10 May–10 Dec. 1963
Griffiss AFB, N. Y., RADC, Dec. 1964 249 p refs
(Contract AF 30(602)-3129)
(RADC-TDR-63-540; AD-610816)

The feasibility of a velocity measurement system based on the Mössbauer effect for use during the liftoff phase of missile flight, was investigated. Such a system is feasible, with range limitations. The system consists of the following: (1) a missile-mounted Sm^{151} Mössbauer radiation source with shielding to permit personnel access to the immediate area prior to launch; and (2) an array of at least three source-absorber relative velocity measurement devices, each in a fixed position near the launch pad, and each of which consists of a servosystem, absorber drive, resonance detection electronics, and absorber velocity pickoff. This system provides a direct velocity measurement during the early launch portion of a missile's liftoff, independent of weather and engine exhaust, to an accuracy not attainable with other proposed systems. Author

N65-18856# AVCO-Everett Research Lab., Everett, Mass.
A SYNCHRONIZED HIGH SPEED SCANNING SPECTROMETER
John C. Camm Feb. 1965 17 p refs
(Contracts AF 04(694)-414; DA-19-020-AMC-0210; ARPA Order-525; Proj. Defender)
(AVCO-Everett Res. Note-447; BSD-TDR-64-166; AD-457912)

A synchronized scanning spectrometer has been built which scans a wavelength region 1000 Å wide with a scanning rate of 35 Å per μsec, starting 15μsec after triggering. The inverse linear dispersion is 350 Å per mm; and the instrument is useful from 1000 Å, the blaze wavelength, to 11 500 Å using the same grating. The instrument is basically an Abney-type monochromator equipped with a radiation detector at the exit slit and a scanning mirror placed 2 in. before the exit slit. The scanning mirror which is supported on pivots inside a helical coil, deflects the spectrum through an angle of approximately 90° onto the exit slit. When a capacitor is discharged through the coil, the resulting magnetic field spins the mirror causing the spectrum to move across the exit slit. Measurements of the absolute spectral radiation intensity of air, nitrogen and oxygen heated by reflected shocks in a shock tube are presented. Author

N65-18899# Geotechnical Corp., Garland, Tex.
SPECIAL-PURPOSE SEISMOGRAPH SYSTEM, PROJECT VT/072
James C. Moore 3 Dec. 1964 77 p
(TR-64-129; AD-454584)

A portable short-period seismograph system was developed which is suitable for noise-survey work, observatory site locations, and similar applications. All components except the seismometer are contained in two portable transit cases. The recorder, timing system, and amplifier components are packaged in one case. The other case contains a battery consisting of 20 nickel–cadmium cells, a battery charger, and a storage compartment for system accessories. The system is designed for use with existing seismometers. The components of new design include a photocell amplifier, a solid-state filter network, a helical drum recorder, a rectilinear penmotor, a timing system, and a fully transistorized power and control circuit. The system is capable of operating up to 16 hr on batteries before recharging. Continuous operation is possible with the battery charger in operation, or by using two battery packs. Author

N65-18900# United ElectroDynamics, Inc., Pasadena, Calif. Earth Sciences Div.
EVALUATION TESTS, J-M SEISMOMETER Special Report No. 12
G. F. Francis 1 Jun. 1964 94 p
(Contract AF 33(657)-7747; Proj. Vela Uniform)
(AD-454257)

Good results for output linearity of the instruments were obtained, and frequency response curves agree well with theoretical predictions. Calibration constants were calculated from the magnifications, and were affected by damping influences on magnification and record amplitude. Galvanometer free period has no effect as long as the frequency response is flat to the natural frequency of the seismometer or magnification-measurement frequency, whichever is higher. Magnifications measured by the shake table are about 15% higher than those measured with the calibration coil, as reflected by the calibration constant calculations. The calculations were verified and seem to be correct, leaving the discrepancy unresolved. E.P.V.

N65-18917*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A SYSTEM FOR LUNAR PHOTOGRAPHY AND DATA TRANSMISSION
John R. Scull 28 May 1960 29 p refs
(Contract NASw-6)
(NASA-CR-57157; JPL-TR-34-142) CFSTI: HC $2.00/MF $0.50

A lunar photography and data transmission approach was developed using a slow scan vidicon television camera in conjunction with 2000:1 bandwidth compression by means of a special 650-gm low power tape recorder. The performance of the prototypes along with the engineering philosophy which led to their development is presented in some detail. Special attention is given to the development of methods for generating, storing and transmitting video information over long distances using low power and subaudio bandwidths. Author

N65-18952# Hanford Atomic Products Operation, Richland, Wash. Physics and Instruments Lab.
GAMMA SPECTROMETER FOR USE IN WHOLE BODY COUNTING
E. M. Sheen Oct. 1964 20 p refs
(Contract AT(45-1)-1350)
(HW-84250) CFSTI: $1.00

A portable gamma spectrometer was developed combining a single channel pulse height analyzer, count-rate meter, 5-decade scaler, and a high voltage supply. All circuitry is solid state and operates from ±8 Vdc supplied by an electronically regulated, battery supply using standard 6-Vdc lantern batteries. The complete instrument, including power supply, weighs 17 lb, and approximately 100 hr of operation can be obtained per set of batteries. Integral linearity of the amplifier and analyzer is ±1%, and the usual baseline and window-width controls are provided. Accurate data readout is obtained with a sequentially switched, meter-indicated, 5-decade scaler. In addition, a count-rate meter was included to permit rapid and simple adjustment to the photopeak of the radionuclide of interest. Author

N65-18956# Atomic Energy of Canada, Ltd., Chalk River (Ontario). Biology and Health Physics Div.
THE MEASUREMENT OF HIGH LEVELS OF RADIATION EXPOSURES. A REPORT OF METHODS AT THE CHALK RIVER NUCLEAR LABORATORIES
G. Cowper Feb. 1965 14 p refs Presented at I.A.E.A. Symp. on Personnel Dosimetry for Accidental High-Level Exposure to External and Internal Radiation, Vienna, 8–12 Mar. 1965
(SM-56129; AECL-2154) Available from Atomic Energy of Canada Ltd., Chalk River: $0.50

The special problems of a radiation accident are discussed. The use of personal and area warning devices is covered, and several instruments are described. Reliability of method is considered more important than accuracy in dealing with emergency high exposure levels. It was recommended that instruments and methods which receive only occasional use should be as simple as possible, and that routine services should be capable of absorbing sudden increases in the workload.
R.L.K.

N65-18970# General Electric Co., Philadelphia, Pa. Power Transmission Div.
AN UNCOOLED, RAPID RESPONSE PROBE FOR MEASURING STAGNATION PRESSURES IN HIGH VELOCITY ARC PLASMA Interim Technical Report, Mar. 1963–Apr. 1964
P. Barkan and A. M. Whitman Wright-Patterson AFB, Ohio, ARL, Nov. 1964 57 p refs
(Contract AF 33(657)-8206S1)
(ARL-64-192; AD-609621)

This report describes a means for measuring stagnation pressures in high-temperature, high-current plasmas. The device employs a small (<0.060-in. o.d.) uncooled pilot tube designed for minimum response time (<0.001 sec) which is rapidly swept through the plasma flow field (<0.015 sec). A simple technique for evaluating the transient response of the probe is described. Because the probe tip is inexpensive and expendable, a moderate amount of molten phase ablation is tolerable in the stagnation zone. Consequently, it appears possible to obtain meaningful results at heat flux rates exceeding 10^4 cal/cm^2-sec. In preliminary tests a single probe was successfully employed for 8 successive measurements of total pressure in an atmospheric-pressure air-arc plasma at currents ranging from 200 to 1000 A at Mach numbers close to unity. Heat flux rates encountered are estimated to be in the vicinity of 2000 to 3000 cal/cm^2-sec. Author

N65-18976# Mithras, Inc., Cambridge, Mass.
A NEW THERMAL DETECTOR Scientific Report No. 5
Terence J. Wieting, Thomas R. Lawrence, and Charles S. Naiman Oct. 1964 18 p refs
(Contract AF 19(628)-2395)
(MC-62-49-R5; AFCRL-64-884; AD-610148)

As part of a study of the dynamic properties of phase transition of ordered magnetic states, experiments were performed that involve measuring the susceptibility of magnetic materials as the applied magnetic field is varied about a value for a critical phase transition to occur. This measurement technique has suggested a new thermal detector that, on the basis of preliminary calculations, promises to have an excellent NEP (10^{-10}–10^{-11}) and whose output would be a frequency proportional to heat input. This detector would provide high level voltage output, output information rate approximately equal to the material time constant, and no requirement for ohmic leads. Theory of operation of the detector, including design factors and a summary of progress to date, is given. A development program is also suggested. Author

N65-19052# Mississippi State Univ., State College. Aerophysics Dept.
A DEVICE FOR REMOTELY DETERMINING THE INITIAL ACCELERATION OF VEHICLES
J. J. Cornish, III and S. C. Roberts Fort Eustis, Va., Army Transport. Res. Command, Nov. 1964 28 p *lts* Aerophys. Res. Note No. 22
(Contract DA-44-177-AMC-892(T))
(TRECOM-TR-64-58; AD-609972)

A device is described which enables the initial acceleration of vehicles from zero velocity to be easily determined. Essentially, the device consists of a prestretched cord, which is attached to the vehicle and unreeled from a rotating drum as the vehicle moves, and a timing and recording mechanism which displays a chart of the vehicle's linear displacement as a function of time. Several examples are presented, and the methods for reducing the data are given. Author

N65-19067# Martin Co., Orlando, Fla.
LOW NOISE MILLIMETER DETECTOR Final Report, Jul. 1963–Aug. 1964
E. Valkenburg Griffiss AFB, N. Y., RADC, Jan. 1965 72 p refs
(Contract AF 30(602)-3183)
(OR-6228; RADC-TDR-64-504; AD-611068)

This report describes a program to determine the optimum crystal materials and detector mount configuration for a low-noise millimeter detector in the frequency range of 280 ±20 Gc. Fifteen semiconductor crystal materials were evaluated for tangential sensitivity and video resistance. Of these materials, silicon, lead selenide, and bismuth telluride exceeded the sensitivity goal of 10^{-10} watts for a bandwidth of one cps and unity signal-to-noise ratio. Sufficient data were obtained for each crystal material to provide a good statistical representation of performance. In addition, reports are made of the following tasks: (1) Measurement of the performance of a photoelectric millimeter-wave detector at 290 Gc. (2) Evaluation of bimetallic contact performance using pointed whiskers on clean metal posts. Author

N65-19072# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORY OF GYROSCOPIC INSTRUMENTS. VOLUME I
Boris Ivanovich Kudrevich 24 Nov. 1964 402 p refs Transl. into ENGLISH of "Teoriya Giroskopicheskikh Priborov. Tom 1" Leningrad, Gos. Soyuzn. Izd. Sudostroitel'noy Prom., 1963 p 3–328
(FTD-TT-63-1100/1+2; AD-611040)

A discussion is presented of some topics in general gyroscope theory, of the theory of vertical gyroscopes, and of gyrostabilization elements. Major sections of the work cover

such areas as the basic equations used to study the gyroscope, the theory of undamped and damped vertical-gyroscope oscillations, the fundamentals of free-oscillation theory for compound gyroscopic pendulums, and directional gyroscopes. This paper is an unedited rough draft translation of the first volume of two on the subject. D.E.W.

N65-19075# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-PRECISION OPTICAL THEODOLITES
B. S. Grishin 23 Nov. 1964 178 p refs Transl. into ENGLISH of "Vysokotochnyye Opticheskiye Teodolity" Moscow, Izd. Geod. Lit., 1959 p 3–148
(FTD-TT-64-653/1+2; AD-611072)

Fundamentals of assembly, dismantling, care, and adjustment of two types of optical theodolites are given in this handbook. Manufacture of parts of the axial system is described, and the study of aberrations in the telescope optical systems is discussed. Testing and investigation of the optical micrometer and theodolite dials are included, as well as the theory of adjustment of the optical systems. E.P.V.

N65-19133# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INSTRUMENT FOR RELATIVE MEASUREMENTS OF THE ACCELERATION OF THE FORCE OF GRAVITY
V. A. Romanyuk 13 Nov. 1964 6 p Transl. into ENGLISH from the Russian Patent no. 156693 (Appl. no. 722516/26-10), 21 Mar. 1961 p 1–4
(FTD-TT-64-239/1+2; AD-609134)

An instrument for relative gravitational measurements by means of nonattenuating pendulum oscillations incorporates metal fittings mounted on a stone monolith to fasten the stand rigidly while the pendulum is elastically suspended. This method decreases the unsteadiness of the stand, and thus increases the precision of the measurements to the mean square error of the acceleration of the force of gravity in the order of ±0.1 mgal. G.G.

N65-19167# Army Electronics Labs., Fort Monmouth, N. J. Meteorological Div.
FULL-RANGE RADIOSONDE HYPSOMETER
Layton E. Clark Dec. 1964 45 p ref
(ECOM-2535; AD-610486)

This is a report on the testing of early (1953) and later (1961) hypsometers. The construction of the critical hypsometric boiling chamber and measuring circuit is the same in both models. Evidence indicates the full-range hypsometers to be inherently accurate to ±100 feet of altitude, providing proper boiling of the liquid is maintained. The tests prove the feasibility and great inherent accuracy of the full-range hypsometer, but added research and redesign are required before these hypsometers can become reliable field units. Author

N65-19188# Army Electronics Labs., Fort Monmouth, N. J. Exploratory Research Div.
CHEMICAL DOSIMETRY OF THE USAEL 3.5 KILOCURIE COBALT 60 IRRADIATION SOURCE
Carol K. Pearce and Joseph E. Ellison, Jr. Nov. 1964 15 p refs
(ECOM-2540; AD-611201)

Results are reported on the calibration of the 3.5-kilocurie cobalt 60 irradiation source using ferrous sulfate chemical dosimetry. Author

N65-19200# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRIC RESISTANCE TENSOMETER
B. A. Glagovskiy, B. M. Rakhman, and U. M. Zubkov 28 Jan. 1965 5 p Transl. into ENGLISH from the Russian Patent no. 153138 (Appl. no. 668220/25), 27 May 1960 p 1–2
(FTD-TT-64-872/1+2; AD-611051)

To expand the boundaries of measurement to the plastic range, the electric resistance tensometer was made from 0.05-mm-thick titanium–aluminum foil, containing 3% to 5% aluminum. The anticorrosion stability of the foil and its nonmagnetic character allow use in caustic media and in electric and magnetic fields. E.P.V.

N65-19252 New Mexico Univ., Albuquerque. Bureau of Engineering Research
AFWL 600 KV FLASH X-RAY FACILITY
Le Roy Meyer and W. W. Grannemann *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 187–192 (See N65-19244 09-24)

The X-ray unit is described and the operating characteristics are reported as 600-kV output voltage, 2000-A output current at peak output voltage, 0.2μsec pulse width, 50-nanoseconds pulse rise time, and approximately 2×10^7 R/sec dose rate. E.E.B.

N65-19267*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INSTRUMENTATION REPORT ON JAVELIN FLIGHT 8.31 DA
J. W. Cameron Oct. 1964 26 p
(NASA-TM-X-55170; X-671-64-277) CFSTI: HC $2.00/MF $0.50

This report contains all pertinent engineering data on actual flight instrumentation, and describes the flight of Argo D-4 Javelin, Flight No. 8.31 DA, which carried the first wraparound, quadraloop antenna. The operation of this antenna was questionable due to rf signal dropouts. Rocket instrumentation performance was excellent, with preliminary results indicating that data were good, and all three experiments functioned throughout. Author

N65-19268*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INSTRUMENTATION AND TRIP REPORT ON FLIGHT NO. 14.79 UE THROUGH 14.82 UE
J. C. Modlin Oct. 1964 26 p
(NASA-TM-X-55171; X-671-64-283) CFSTI: HC $2.00/MC $0.50

This report contains all pertinent engineering data on actual flight instrumentation, and documents the flight results of Flight 14.79 UE through 14.82 UE. These rockets were fired from a station near Trivandrum in southern India. In addition, this report contains a collection of practical and useful information relating to travel, business, and diplomatic needs. Author

N65-19290# General Electric Co., Ithaca, N. Y. Advanced Electronics Center
THE VISILOG: A SYNTHETIC EYE Technical Documentary Report, 1 Jul. 1963–29 Feb. 1964
Paul W. Charton and Erman E. Ferris Jan. 1965 76 p refs
(Contract AF 33(657)-11179)
(AL-TDR-64-185; AD-611539)

The VISILOG is an automatic obstacle avoidance machine whose principle of operation is based upon the analog of the visual senses. The subject of this investigation was a stationary slant-perceiving VISILOG, where the slant of a surface is measured by use of the texture density gradient as observed in the retinal plane. The accuracy of the VISILOG surface slant-measuring technique is shown to be highly dependent upon the number of texture elements in the field of view scanned. Experimental verification of the VISILOG method of measuring surface slant is obtained and the effects of stochastic surfaces upon measurement accuracies are demonstrated. The results obtained on this program indicate that the stationary slant measurement VISILOG is useful only in limited environmental situations. Author

N65-19349# Suffield Experimental Station, Ralston (Alberta).
SUFFIELD 500 TON BLAST TRIAL CANADIAN FIELD INSTRUMENTATION
F. H. Winfield and B. G. Laidlaw 30 Dec. 1964 34 p refs
(Suffield-TN-129)

A wide variety of scientific measurements were made on the 500-ton trial in July 1964. Many of the measurements were made close to the charge, and included measurements in the air, and on and below the surface of the ground. The layout of gages, cables, and support engineering used in the Canadian experiments is described, along with the apparatus and instrumentation installed by P & M Section for the Emergency Measures Organization, McGill University, and Army Equipment Engineering Establishment. Author

N65-19377# White Sands Missile Range, N. Mex.
METHODS FOR ESTIMATING ACCURACY OF POSITION, VELOCITY, AND ACCELERATION DATA
Jun. 1964 49 p refs
(IRIG-103-64; AD-602766)

Mathematical methods for estimating the accuracy of position, velocity, and acceleration data from instrumentation systems are examined from the viewpoint of standardizing these techniques. Discussed are: *Definition and Discussion of Errors; Methods Used to Estimate Random Errors and to Evaluate Systematic Errors; Velocity and Acceleration Determination;* and *Theory of Acceleration Determination.* G.G.

N65-19478# Rocket Propulsion Establishment, Westcott (England).
A MOLECULAR BEAM DETECTOR WITH ELECTRON COLLISION IONISATION AND QUADRUPOLE MASS FILTER [EIN MOLEKULARSTRAHLDETEKTOR MIT ELEKTRONENSTOSSIONISIERUNG UND VIERPOLMASSENFILTER]
H. G. Bennewitz and R. Wedemeyer London, Min. of Aviation, Jun. 1964 26 p Transl. into ENGLISH from Z. Physik (Berlin), no. 172, 1963 p 1-18
(RPE-TRANS-12)

A molecular beam detector is described which ionizes by electron bombardment. The ions are then separated in a quadrupole mass filter and detected by a multiplier. The ion current due to the residual gas is reduced by a factor of 10^{-6} for all masses greater than 45. These results were achieved without separately pumping or baking out the ionization chamber. Since magnets are not used the detector is comparatively light and small in size. The smallest detectable beam was found to have a current density of 1.8×10^{-6} molecule $sec^{-1} mm^{-2}$ corresponding to 4×10^{3} molecule cm^{-3}, at a vacuum pressure of 8×10^{-7} torr in the apparatus, and using a time constant of 1.25 second. Author

N65-19515# India. Dept. of Atomic Energy, Bombay. Spectroscopy Div.
SETTING UP OF THE 22 FT CONCAVE GRATING SPECTROGRAPH (EAGLE MOUNTING)
K. V. S. R. Apparao, P. Ramakoteswara Rao, and G. D. Saksena 1964 32 p refs
(AEET-SPEC-2)

An eagle-type mounting for a large concave grating spectrograph of 22-ft radius curvature and a surface area of 7 in. × 4 in. with 30000 lines per inch is described. The astigmatism in this mounting is close to the minimum obtainable by concave gratings if the angles of incidence and diffraction do not exceed 40°. Testing of the resolving power of the spectrograph without temperature or humidity control through photographs of the 2536 Å line of Hg in the third order established it at 118300 which is 70% of the practical resolving power 160000. A photograph of the P_2 band at 2809.3 Å in the second order is presented. Effects of a change in temperature, pressure, and humidity were theoretically evaluated and found minimal. G.G.

N65-19653# National Bureau of Standards, Boulder, Colo. Cryogenic Div.
CONSIDERATIONS WHEN USING TURBINE TYPE FLOWMETERS IN CRYOGENIC SERVICE
W. J. Alspach and T. M. Flynn [1964] 20 p refs Presented at the 1964 Cryog. Eng. Conf., Philadelphia, 17-21 Aug. 1964 (M-3) Available from Natl. Bur. of Standards, Boulder, Colo.: $2.00

The turbine-type flowmeter is a popular means of measuring cryogenic flow. It has the advantages of small size, light weight, repeatability, and low response time. However, when used in cryogenic service, considerations should be made for rotor overspeed, thermal effects, viscosity effects, calibration, attitude, piping, and reverse flow. This paper discusses these advantages and cryogenic service considerations of turbine-type flowmeters. Author

N65-19656# Aeronautical Chart and Information Center, St. Louis, Mo.
CARTOGRAPHIC REDUCTION OF RANGER VII MISSION
Dec. 1964 16 p
(ACIC-TP-16; AD-609262)

A series of five charts was prepared from the photographic data produced by the Ranger VII mission. These charts are described. Characteristics of the data are given, including cameras, calibration, scanning sequence, telemetry, and the orbit and trajectory of the Ranger vehicle. Processes of data reduction included the preparation of a photographic mosaic and relief drawings, the measurement of shadows, and the computation of relative heights. Techniques of preparing and using stereoscopic views of the lunar surface are described. D.E.W.

N65-19741# Federal Aviation Agency, Atlantic City, N. J. Systems Research and Development Service Evaluation Div.
EVALUATION OF A DUAL RADAR ALTIMETER INSTALLATION FOR USE WITH AN AUTOMATIC LANDING SYSTEM Final Report
James C. Muir Jul. 1964 45 p refs
(RD-64-100)

An operational evaluation of dual-pulse-type radar altimeters, installed in a DC-7 transport aircraft, was conducted. Two Honeywell Model 7182 Radar Altimeters were integrated into an automatic landing system which used radar altimeter height information for vertical guidance during

the flareout and landing. A total of 391 automatic landings were made on 31 instrument landing systems during the evaluation period. Space position data from 109 runs were recorded on the ground-based phototheodolite camera system. Based on the results obtained during this evaluation, it was concluded that simultaneous operation of dual radar altimeters in a large transport aircraft was feasible without mutual interference, and the automatic landing system performance when using pulse radar altimeter information was equivalent to that obtained when using frequency-modulated continuous-wave altimeter information with a substantial reduction in weight. Author

N65-19842# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugzeugbau
MEASURING, BY MEANS OF A CAPACITANCE TRANSDUCER, OF BUCKLING AND VIBRATION OF THIN-WALLED CIRCULAR CYLINDRICAL SHELLS [KAPAZITIVE WEGMESSUNG BEI BEUL- UND SCHWINGUNGSUNTERSUCHUNGEN AN DUNNWANDIGEN KREISZYLINDERSCHALEN]
H. D. Garkisch and H. W. Schwarz Dec. 1964 54 p refs In GERMAN; ENGLISH and FRENCH summaries
(DLR-FB-64-42) Available from ZLDI, München: 10 DM

A testing device is described for measuring the invisibly small deflections of a thin-walled circular cylindrical shell made of plastic foil and subjected to compression, to external pressure, or to vibrations. A new capacitance-type transducer was developed for this purpose. A description of the performance of the setup is presented. Author

N65-19883*# Eppley Lab., Inc., Newport, R. I.
DESIGN STUDY—SOLAR SPECTRAL MEASUREMENT PROGRAM Final Technical Report
1 Aug. 1964 72 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950929)
(NASA-CR-57509) CFSTI: HC $3.00/MF $0.75

A new technique for manufacturing electrochemically coated thermopiles is described. A detector of the type investigated will exhibit a low temperature coefficient, and may not need a temperature compensation circuit since a minimum decrease from highest sensitivity will be experienced. No damage to the models tested in vibration and thermal shock environments was observed. The general requirements of the filters are discussed, and investigations are reported for spectrophotometric and transmittance measurements on filters in the ultraviolet-near visible range region. Lens selection and test procedures are described in connection with optical amplification of the detector signal, and calibration procedures are described for the detector. E.P.V.

N65-19927*# Chicago Univ., Ill. Lab. for Astrophysics and Space Research
THE COSMIC RAY TELESCOPE FOR THE MARINER-MARS MISSION Final Engineering Report
James E. Lamport [1964] 19 p Prepared for JPL
(Contracts NAS7-100; JPL-950615)
(NASA-CR-57515) CFSTI: HC $1.00/MF $0.50

Tests of components of the cosmic-ray telescope for the Mariner C spacecraft are reported. Results of thermal vacuum tests of various units, their discriminator levels, detectors and sources, and specific causes of failure, are listed. A narrative of project activities leading up to the launch of the Mariner IV Mars mission is given. J.M.D.

N65-19958*# Columbia Univ., Palisades, N. Y. Lamont Geological Observatory
DESIGN AND CONSTRUCTION OF A LUNAR SEISMOGRAPH Progress Report No. 10, 1 Oct.–31 Dec. 1961
[1961] 5 p
(Contract NASw-82)
(NASA-CR-60891) CFSTI: HC $1.00/MF $0.50

Procurement, installation, calibration, and testing of Ranger data analysis equipment were completed. Successful reproduction of instant moonquake data is reported. The prototype model seismograph system for the Surveyor soft lunar landing project was readied for operational testing. Improvements and innovations in equipment and techniques for thermal control and level sensing are summarized. E.P.V.

N65-19975# Weston Instruments, Inc., Newark, N. J.
COMPUTER ACTIVATED ELECTROLUMINESCENT DISPLAY SCREEN. APPLICATION OF LIGHT AND IMAGE INTENSIFICATION TECHNIQUES, PHASE I Final Report
Martin Kaplan, William Laeng, Wolf Merel, and Irwin Munt Port Washington, N.Y., Naval Training Device Center, Oct. 1964 121 p refs
(Contract N61339-656)
(NAVTRADEVCEN-656-1; AD-612278)

The topics studied include (1) the mathematics used to represent the changing perspective of objects on the display screen; (2) computers to solve the perspective equation; and (3) electroluminescent display techniques and displays. A breadboard model was constructed to demonstrate the feasibility of the overall system, and to provide a research tool for additional system study. The display media is a suppressed cross-grid electroluminescent panel having a useful area of 256 sq in. The panel area is comprised of an assembly of four display modules demonstrating the technology required for constructing large area displays. Panel access is achieved by pulse drivers which are sequentially addressed by a decoder matrix converting two eight-bit codes to one each of 256 X and 256 Y commands. Perspective information is generated in real-time by a computer simulator containing punched tape and magnetic tape conversion equipment The breadboard model was used to generate dynamic displays of two solid objects with changing perspective. A digital computer was used as a tool to solve the perspective equations and represent the objects via the breadboard as they appear from a continuously moving point in space. Additional study is recommended leading to larger displays with more complex scenes including gray scale. Author

N65-20082# Army Missile Command, Huntsville, Ala. Structures and Mechanics Lab.
EFFECT OF THERMOCOUPLE SIZE AND INSTALLATION ON TEMPERATURE READINGS
Noah J. Hurst 8 Apr. 1964 21 p ref
(RS-TM-64-1; AD-612493)

Measurements of constant and varying temperature were made using separate and bead installations of thermocouples in copper and aluminum. The results were analyzed by a statistical variance method. It was concluded that for the heat fluxes (30- and 60-Btu/ft^2-sec) and wire sizes (no. 24 and 30) used, there is no significant difference in the readings. E.P.V.

N65-20089# Osterreichische Studiengesellschaft für Atomenergie G.m.b.H., Seibersdorf (Austria). Reaktorzentrum
RESULTS ON A NEW ELECTROSTATIC TIME OF FLIGHT MASS SPECTROMETER DEVELOPED AT THE REACTOR CENTER SEIBERSDORF

M. J. Higatsberger, F. P. Viehböck, F. Rüdenauer (Wien Univ.), and F. Buschbeck 25 Aug. 1964 41 p refs Presented at Reunion sur la Spectrometrie de Masse, Paris, 14–18 Sep. 1964 (SGAE-PH-9/1964)

A mass spectrometer which employs parabolic flight paths for energy selection is described. Mathematical treatment of such a system is given. Details on the analyzer and the electronic circuit of a prototype instrument are reported. First experimental tests were performed, and the results are in good agreement with theory. Author

N65-20103*# Radio Corp. of America, Princeton, N. J. Astro-Electronics Div.

TIGRIS (TELEVISED IMAGES OF GASEOUS REGIONS IN INTERPLANETARY SPACE) TELEVISION CAMERA SYSTEM Final Engineering Report, Oct. 1963–Oct. 1964

15 Jan. 1965 60 p

(Contract NASw-823)

(NASA-CR-57532; AED-R-2583) CFSTI: HC $3.00; MF $0.50

A preprototype model of the sensitive image orthicon camera has been designed and tested for the TIGRIS Program (Televised Images of Gaseous Regions in Space). The sensitivity, determined by the brightness of the weaker astronomic sources, is 2.8×10^{-8} watts/ft^2 sterad (surface brightness of a cloud). The illuminance produced by the cloud brightness on the photosensitive surface of the image orthicon tube by a lens having an effective aperture of f/2.8 is 2.66×10^{-7} foot-candles. Since cloud-type formations are to be observed, resolution is not too critical. Tests indicated a resolution exceeding the minimum of 200 lines for comparable levels of light intensity. E.P.V.

N65-20111*# Optics Technology, Inc., Belmont, Calif.

ULTRA-HIGH SPEED ELECTRO-OPTICAL SYSTEMS EMPLOYING FIBER OPTICS Final Report

N. S. Kapany, J. J. Burke, D. F. Capellaro, and N. A. Peppers 30 Nov. 1962 107 p refs

(Contract JPL-950136; NAS7-100)

(NASA-CR-57526) CFSTI: HC $4.00/MF $0.75

The design and development of high photographic speed, wide angle, high resolution optical systems using fiber optics image correctors as fiber optics field flatteners, distortion correctors, and conical condensers are reported. Marked improvement in the performance of five different systems (cemented and uncemented telescope doublets, landscape doublet, symmetric Hypergon, and Pantoskop) and in a two-element reflector system was achieved. The fabrication and testing of a refracting and a reflecting system using a fiber optics field flattener and conical condenser showed that an f/3.5 lens is capable of 150 to 200 lines/mm resolution over a 60° field angle, and is capable of yielding an effective f-ratio less than f/1 and resolution of 70 to 100 lines/mm when used with a conical condenser. Several optical systems designs with a known amount of aberrations were evaluated using image synthesizer techniques. The importance of studying diffraction effects in high quality systems was demonstrated and the limitations of geometrical optics were emphasized. S.C.W.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N65-18693# SKF Industries, Inc., King of Prussia, Pa. Research Lab.

A BASIC STUDY OF THE SLIDING CONTACTS IN ROLLING BEARINGS Progress Report No. 2, Jul. 17–Oct. 16, 1964

C. J. Belsky, K. Tataiah, S. C. Chou, and J. Kamenshine [1964] 63 p refs

(Contract NOw-64-0428-c)

(AL64L087; AD-609042)

A gaging technique was used to measure the skew and axial motion of the rollers in a rotating cylindrical roller bearing. The signal from the distance gage was tape recorded for subsequent playback into a recording oscillograph. The wave signal shape is essentially a trapezoidal wave, with a slanted top if the roller is skewed. Tabulated test data are reported. A typical visicorder trace indicating the angles and distances measured is included. Data sheets obtained directly from the recorded visicorder trace list angles which are not actual skew angles but measured values. To obtain the skew angles, they must be multiplied by a calibration constant. E.E.B.

N65-18746 Joint Publications Research Service, Washington, D. C.

PROPERTIES OF CRANKSHAFTS CAST FROM CERIUM CAST IRON

V. V. Zvolinskaya *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 351–356 refs (See N65-18701 09-17) CFSTI: $7.00

In the investigated crankshaft design, the strength proved to be highest in the places where the greatest stresses arose. Elements of crankshafts made from forged steel, magnesium cast iron, and cerium cast iron were fatigue tested and compared. The cast iron crankshafts possessed somewhat reduced fatigue strength (10 kg/mm^2 as opposed to 12 kg/mm^2) in comparison to the steel when the difference in the cross sections of the cast iron and the steel crankshafts were considered, the total fatigue resistance was almost the same. E.P.V.

N65-18789*# National Aeronautics and Space Administration, Washington, D. C.

[A RESEARCH PROGRAM DEALING WITH THE DEVELOPMENT OF THERMAL CONTROL COATINGS FOR SPACE VEHICLES]

Conrad P. Mook [1964] 7 p Presented at the Govt. Paint Symp. Ann. Meeting of Natl. Paint, Varnish and Lacquer Assoc., Dallas, 11 Nov. 1964

The need of special coatings for space vehicles that reflect or absorb specified amounts of solar radiation and conversely radiate heat at a known rate, and that can withstand ultraviolet radiation, high-energy particle radiation of the Van Allen regions, corpuscular radiation originating in the universe, and flying bits of debris is discussed by Conrad P. Mook from the National Aeronautics and Space Administration. Emphasis is placed on white paints, and the combinations of zinc oxide with a silicon binder as well as a titanium dioxide pigmented coating with a silicon binder were considered for application. G.G.

N65-18820* National Aeronautics and Space Administration, Washington, D. C.

DEVELOPMENT OF ROCKET-CHAMBER WELDING TECHNIQUES

Yoshio Anto *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 129–135 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The welded rocket chambers in boosters of Kappa and Lambda rockets are described; these are observation rockets

in the Japanese space program. For the Lambda-735 chamber, high-strength uniform sheet steel was used; unfinished, rolled thin-sheet steel was chosen for the Kappa-420H model. Chemical composition and mechanical properties of various steels are presented; similar data are given for molten metals of the rods used in the welding process. One steel was concluded to be appropriate for highly reliable but inexpensive rocket chambers. J.M.D.

N65-18875# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
PYROLYTIC COATING OF CARBON FILAMENTS Final Report, May 15, 1963–May 15, 1964
K. J. Zeitsch and P. H. Higgs Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 160 p refs
(Contract AF 33(657)-11297)
(ML-TDR-64-297; AD-608764)

A continuous process has been developed to coat the individual filaments of graphite yarn with pyrolytic graphite. The pyrolytic coating increased the strength-to-weight ratio of the filaments and acted as a sizing on the yarn to make weaving easier. Tapes woven from the coated yarn showed a load distribution factor as high as 0.9. Author

N65-18883# General Electric Co., Auburn, N. Y. Semiconductor Products Dept.
QUALITY CONTROL MANUAL, VOLUME II
[1964] 179 p
(Contract DA-36-039-AMC-03619(E))
(AD-434272)

Quality control procedures currently in effect within the Rectifier Components Department are described. Included are sections on engineering drawing control, incoming material evaluation, inprocess inspection, product acceptance, warehouse control, corrective action, packaging and transportation, and control of electrical and mechanical measuring equipment. R.L.K.

N65-18897# Naval Ordnance Lab., White Oak, Md. Non-Metallic Materials Div.
SOME PROPERTIES OF NOL RINGS OF CARBON-BASE FIBERS AND EPOXY RESIN
Stanley P. Prosen Feb. 1965 24 p refs
(NOLTR-64-183; AD-454635)

The recent improvement in the strength and the modulus of carbon-base fibers indicates that such fibers will soon compete with glass in composite structures where light weight is important. Carbon fibers, made by the pyrolysis of rayon yarn, were evaluated in the ring form. A composite tensile strength of 5600 kg/cm^2 (80 000 psi), a compressive strength of over 7000 kg/cm^2 (100 000 psi), and shear strengths of over 350 kg/cm^2 (5000 psi) were measured. A compressive modulus of over 0.28×10^6 kg/cm^2 (4×10^6 psi) was also determined. Several ring fabrication difficulties were encountered, with poor wetting and some fuzzing due to broken filaments causing the most trouble. The rings were somewhat porous, but in general the rings were satisfactory. Author

N65-18912*# Martin Co., Baltimore, Md.
[FABRICATION OF HELIUM STORAGE BOTTLES] Fifth Quarterly Progress Report, Nov. 1964–Jan. 1965
[1965] 3 p
(Contract NAS8-11555)
(NASA-CR-57147) CFSTI: HC $1.00/MF $0.50

Units 11 to 15 of the helium storage bottles underwent heat treatment and the volumetric test bars of three units failed to meet elongation requirements. Two of the six units were reheat treated and met the new hardness requirements, with small distortion of the bosses. A cold spot in the furnace was repaired. G.G.

N65-18913*# Boeing Co., Wichita, Kans.
AGE FORMING OF CENTER PIECE HEAD S-1C Final Report
Robert W. Lightstone Jan. 1965 48 p
(Contract NAS8-11717)
(NASA-CR-57163) CFSTI: HC $2.00/MF $0.50

The objective of this investigation was to determine the capabilities of age forming 2219-T37 aluminum to a compound curved form in the configuration represented by the Saturn S-1C bulkhead center piece. The geometric shape of the part is a segment of an ellipsoidal shell. A fixture was fabricated with interchangeable die and punch inserts so that variables of thickness and depth of curvature could be investigated, using one aging fixture. Age formed test parts were measured for amount of curvature retention, effect of grain direction, and growth of the alloy. These conclusions resulted: (1) The age forming of compound contoured configuration proved feasible and repetitive for consistent manufacturing capability. (2) The percent of retention varies with thickness. (3) The percent of retention is greater in the longitudinal grain than in the transverse grain direction and varies at the same rate with respect to material thickness. (4) Material growth occurs in all directions and varies to a limited extent with grain direction and thickness. Author

N65-18997# Aeroprojects, Inc., West Chester, Pa.
ULTRASONIC WELDING PROCESS AND EQUIPMENT FOR CONSTRUCTION OF ELECTRON-TUBE MOUNTS Quarterly Progress Report, Apr. 1–Jun. 30, 1964
J. G. Thomas [1964] 11 p
(Contract DA-36-039-SC-86741)
(QPR-8; AD-609935)

Efforts originally directed toward ultrasonic welding of the Types 5814WB and 6205 electron tubes have been replaced by a concentrated effort to obtain a totally ultrasonically welded Type 6080WB tube with superior performance capabilities to those presently in production. A tungsten–3% rhenium alloy wire was developed with properties of significant interest to electron-tube manufacturers Preliminary investigation of ultrasonically welding the tungsten–3% rhenium wire indicates that power requirements are beyond the capability of a 100-watt unit. Author

N65-19092# Northrop Corp., Hawthorne, Calif. Norair Div.
DEVELOPMENT OF MANUFACTURING CAPABILITY FOR PRODUCING HIGH PERFORMANCE ALUMINUM AND MAGNESIUM ALLOY CASTINGS Quarterly Progress Report No. 3, 1 Nov. 1964–31 Jan. 1965
A. J. Iler Feb. 1965 27 p refs
(Contract AF 33(615)-1341)
(NOR-65-28; AD-610852)

Accounts are given of the tabulation of mechanical properties achieved in the alloys under study, and of the stress corrosion testing currently being performed. Effects of the zinc and silver content of the Mg-Zn-Ag-Zr alloys studied are summarized under metallurgy and founding behavior, and under physical and mechanical properties in the casting. Data are presented in graphs and tables on the properties of these alloys and on effects of various parameters on these properties. The mechanical properties

of three aluminum alloys were investigated and are tabulated. The progress of a stress corrosion testing program is reported. D.E.W.

N65-19134# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LUBRICATING AND PACKING SYSTEMS (CHAPTER 20)
I. V. Mazyrin 23 Nov. 1964 50 p refs Transl. into ENGLISH from Spravochnik Mashinostr. v Shesti Tomakh (Moscow), v. 4, pt. 2, 1963 p 745–788
(FTD-TT-64-343/1+2; AD-609145)

Lubricating systems, distinguished as to period of action, method of application, and form of operation, are tabulated giving type, system, application, and comments. Grease lubrication; regulatory, safety, and distributory devices in oil and grease systems; and methods for cleaning or filtering lubricants are discussed. E.E.B.

N65-19203# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
WELDING (SELECTED ARTICLES)
9 Jan. 1965 22 p refs Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 5, 1964 p 36–45
(FTD-TT-64-1298/1+2; AD-610408)

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1. ON SHORTCOMINGS OF SOME SOLDERING WORK I. I. Il'yevskiy p 1–12 refs (See N65-19204 09-15)
2. ANSWER TO THE ARTICLE BY I. I. Il'YEVSKIY, ON "SHORTCOMINGS OF SOME SOLDERING WORK" S. V. Lashko and N. F. Lashko p 13–19 refs (See N65-19205 09-15)

N65-19204 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON SHORTCOMINGS OF SOME SOLDERING WORK
I. I. Il'yevskiy *In its* Welding (Selected Articles) 9 Jan. 1965 p 1–12 refs (See N65-19203 09-15)

A book on soldering is reviewed critically. *Soldering of Metals*, by N. F. and S. V. Lashko, concerns breakdown of joints during soldering, and breakdown of soldered structures in use. The book is said to illustrate the lack of theoretical basis for soldering practices, and the need for higher publication standards. J.M.D.

N65-19205 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANSWER TO THE ARTICLE BY I. I. Il'YEVSKIY, ON "SHORT-COMINGS OF SOME SOLDERING WORK"
S. V. Lashko and N. F. Lashko *In its* Welding (Selected Articles) 9 Jan. 1965 p 13–19 refs (See N65-19203 09-15)

The book *Soldering of Metals*, by N. F. and S. V. Lashko, is discussed by its authors. In particular, they summarize the book's exposition on the causes of crack formation in soldered structures. Much of the discussion is a rebuttal of a reviewer's criticisms of the book. J.M.D.

N65-19301# Battelle Memorial Inst., Columbus, Ohio.
JOINING OF ZIRCALOY AND INCONEL 600 TUBES BY EXPLOSIVE WELDING
Ronald J. Carlson and Charles C. Simons 19 Feb. 1965 38 p
(Contract W-7405-ENG-92)
(BMI-1715) CFSTI: $1.00

Procedures were developed for producing 3.500-in.-o.d. by 3.300-in.-i.d. Zircaloy-to-Inconel tubular transition joints by explosive techniques. Initial experiments were conducted using a lap joint configuration to allow convenient variation of explosive welding parameters. It was determined that a minimum clearance of 0.040 in., a charge weighing considerably in excess of 60 g and located at a minimum standoff distance, and either a grooved or a threaded joint interface were required to achieve welding. The program was directed toward achieving welds with a tapered joint interface. The factors investigated included charge weight, surface roughness, evacuation of the joint interface prior to welding, included angle at the joint interface, and configuration of the joint interface. It was found that surface roughness and included angle had little to no effect within the ranges investigated on the welding achieved. Contact charges of 10 to 12 g per $in.^2$, a scalloped joint interface formed by machining the mating surface of the Zircaloy tube, an initial clearance of 0.040 in., and a vacuum of ~ 20μ of mercury were required to effect the desired welding. These explosively welded tubular transition joints possessed an average tensile strength of 97 500 psi at 10% elongation over a 2-in. gage length and exhibited excellent behavior during thermal cycling from 150° to 750° F. Author

N65-19355# Electronic Systems Div., Bedford, Mass.
HANDBOOK FOR RELIABILITY AND MAINTAINABILITY MONITORS
G. H. Allen, J. R. Barton, R. M. De Milia, G. Grippo, and J. E. Horowitz Dec. 1964 312 p refs
(ESD-TDR-64-616; AD-611577)

The ESD Reliability and Maintainability (R/M) Staff originally prepared a series of pamphlets dealing with R/M matters during 1963–64. These were combined into a single handbook for ready reference and assimilation by ESD personnel associated with R/M programs. Each section of this handbook deals with a particular problem area in R/M matters and suggests methods of initiating and operating an R/M program. The material covered ranges from the basic elements of establishing a program through the engineering requirements to be evaluated in design reviews. The overall operations involved in monitoring of a contractors program are defined. Several sections deal with the mathematical aspects of reliability decision making including construction of probability of acceptance curves. Author

N65-19390# Dayton Univ., Ohio. Research Inst.
THE EVALUATION OF HIGH TEMPERATURE MATERIALS. SECTION I: EVALUATION OF COATINGS FOR REFRACTORY ALLOYS, SECTION II: MATERIALS EVALUATION WITH AN ARC-PLASMA-JET Technical Documentary Report, Jun. 1963–Apr. 1964
J. C. Wurst and J. A. Cherry Sep. 1964 169 p refs
(Contract AF 33(616)-7838)
(ML-TDR-64-62, Vol. II; AD-610687)

The evaluation of candidate materials for high-temperature service is presented in two separate sections: one pertaining to the evaluation of refractory alloy coatings; and the other to the arc-plasma-jet evaluation of ablative materials, impregnated porous ceramics, and refractory composites. The evaluation of oxidation-resistant coatings for TZM molybdenum (Mo–0.5Ti–0.07Zr–0.03C) and B66 columbium (Cb–5V–5Mo–1Zr) is described. Test results covering complete metallographic analysis, tensile and bend tests, cyclic oxidation tests in the temperature range of 1600° to 3000° F, and the results of creep-rupture tests complete with a statistical analysis are presented. The screening tests of 32 different high-temperature materials in an arc-plasma testing facility are described. Included are screening data for several refractory materials developed from tests of 1-in.-diameter discs. This disc test and its relative merits as compared to more conventional flat panel tests are discussed.

Materials performance data are presented as a tabulation of test conditions and their effects upon specimen behavior. Performance indices include weight loss, depth and volume of erosion, density change, and surface temperature behavior. Author

N65-19419# Rock Island Arsenal Lab., Ill.
COMPARISON OF AUTOMOTIVE LUBRICATING GREASES
S. Fred Calhoun, Richard Faoro, and R. L. Young 21 Dec. 1964 12 p refs
(RIA-TR-64-3578; AD-611090) CFSTI: $0.50

Six commercial automotive greases were evaluated along with one qualified MIL-G-10924B grease. The tests were (1) worked penetration, (2) four-ball wear and extreme pressure, (3) roll stability, (4) water washout, (5) water resistance, and (6) rust prevention. Results indicate the MIL-G-10924B grease to be better than average in wear, extreme pressure, and roll stability, and superior in rust prevention and water resistance. Author

N65-19427# Naval Ordnance Test Station, China Lake, Calif. Propulsion Development Dept.
THE APPLICATION OF ULTRASONICS TO WIRE DRAWING Quarterly Progress Report, 1 Jul.–30 Sep. 1964
A. T. Robinson, J. C. Connelly, and L. M. Stayton Nov. 1964 23 p refs
(NOTS-TP-3675; TPR-382; AD-610058)

A new wire drawing facility has been designed which will accommodate a continuous draw, and increase the permissible drawing rate from 2.0 to 700 feet/minute. A paper *The Application of Ultrasonic Energy to Metal Wire Drawing* is included. Author

N65-19429# Hercules Powder Co., Cumberland, Md. Allegany Ballistics Lab.
ROCKET MOTOR CASE WINDING PATTERN STUDIES Final Project Progress Report, 1 May–31 Dec. 1963 and 1 Feb.–31 May 1964
D. P. Hanley [1964] 27 p refs
(AD-447679)

No significant differences in performance of subscale A3 and Large Motor (LM) chambers were observed between multicircuit geodesic or multicircuit planar winding patterns. For both chambers, the performance was 10% to 15% less for single-circuit planar winding paths. Overall strength/weight indices were about the same for simplified subscale versions of the chambers, being 2.1 to 2.3 and 2.3 to 2.5. Skirts on both chambers increased the burst performance on the order of 10% to 15% by reinforcing against the inward deflections of the domes in the juncture area. Layer sequence of hoop/helical windings had no effect on the burst strength of subscale A3 chambers. As a result of this work, it has been recommended that LM Polaris be fabricated using multicircuit winding path and multiroving fiber configurations. E.E.B.

N65-19430# Union Carbide Corp., Lawrenceburg, Tenn. Advanced Materials Lab.
PYROLYTIC COATING OF CARBON FILAMENTS Final Report, 15 May 1963–15 May 1964
R. M. Bushong et al Nov. 1964 150 p refs
(Contract AF 33(657)-11297)
(ML-TDR-64-297; AD-608764)

A continuous process was developed to coat the individual filaments of graphite yarn with pyrolytic graphite. The pyrolytic coating increased the strength-to-weight ratio of the filaments by a factor of 1.3 and acted as a sizing on the yarn to make weaving easier. Tapes woven from the coated yarn showed a load distribution factor as high as 0.9. Author

N65-19438# Ampex Corp., Redwood City, Calif.
FOIL BEARINGS—THEIR GENERAL BEHAVIOR WITH PARTICULAR EMPHASIS ON THE EXTERNALLY PRESSURIZED BEARING
M. Wildmann Dec. 1964 39 p refs
(Contract Nonr-3815(00))
(RR-64-13; AD-610573)

The equations describing the behavior of foil bearings are set forth, and linearized solutions to these equations are obtained. These solutions are used to examine the effects of foil stiffness and lubricant compressibility. Finally, the behavior of a foil of finite stiffness in the vicinity of a pressurizing groove is analyzed in detail, and the results of this analysis are used to design externally pressurized foil bearings. Author

N65-19446# Aerojet-General Corp., Sacramento, Calif. Advanced Storable Engine Program Div.
HYDROSTATIC BEARING FEASIBILITY PROGRAM Quarterly Progress Report, 1 Jul.–30 Sep. 1964
1 Dec. 1964 67 p refs
(Contract AF 04(611)-7439)
(Rept.-7439-Q-1; AD-609628)

Work on the analysis of the applicable laminar and turbulent flow laws to externally pressurized liquid-lubricated journal bearings resulted in the formation of equations for bearing pressure distribution, load-carrying capacity, fluid film stiffness, torque, horsepower loss, and coolant temperature rise that are applicable in orifice, capillary, and constant flow compensation. Computer programs to solve the equations were prepared for journal and thrust bearings under laminar and turbulent flow conditions. The laminar flow computer programs did not yield all required data. An analysis of large turbopump bearing requirements led to the design of journal and thrust bearings, their test plans, and performance prediction. Hydrostatic thrust bearings appear to be feasible for high-speed application, very high load-carrying capacity requirements, or where the viscosity and lubricity of the fluid are not conducive to the use of rolling contact or hydrodynamic bearings. G.G.

N65-19463# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
AUTOMATIC INDUCTION SOLDERING Development Report
M. J. Davis Mar. 1965 9 p ref
(SC-DR-65-74)

Infrared radiometer-controlled induction soldering was used to solder stainless steel connector bodies to brass cable assemblies. It was found that this process uses less heat and maintains a lower surface temperature than uncontrolled induction processes. Flat, concentrating types of heating coils are recommended for heating of circular joints, and hinged single-turn induction coils for soldering joints at necked-down sections of a cable assembly. Combinations of magnetic and nonmagnetic joint materials require more precise positioning and should be avoided, and all joints should be designed to minimize differential expansion. G.G.

N65-19527# ARO, Inc., Arnold Air Force Station, Tenn.
TESTS OF DRY COMPOSITE LUBRICATED BEARINGS FOR USE IN AN AEROSPACE ENVIRONMENTAL CHAMBER, MAY 1–JUNE 16, 1964

T. L. Ridings Arnold Eng. Develop. Center, Mar. 1965 45 p refs
(Contract AF 40(600)-1000)
(AEDC-TR-65-35; AD-458414)

This report contains the results of a test program to determine the operational characteristics of dry composite lubricated bearings. Two different bearing types were tested: tapered roller bearings and ball bearings. Four dry composite lubricants and two low vapor pressure greases were tested. Results indicate that the dry composite lubricants were more successful when used with ball bearings than when used with tapered roller bearings. All four composite lubricants provided low system torques (40 to 60 lb in.) under heavy loads (3000 lb/bearings) for the scheduled 100 hours. Best results were obtained using Cu and PTFE and WSe_2 and a silver alloy + PTFE + WSe_2. One low vapor pressure grease was successful as a lubricant at room temperature but migrated at temperatures above room temperature. The other low vapor pressure grease was successful at temperatures up to 140° F with no migration. Author

N65-19696*# Electro-Optical Systems, Inc., Pasadena, Calif.
RESEARCH AND DEVELOPMENT OF HIGH EFFICIENCY LIGHTWEIGHT SOLAR CONCENTRATORS Interim Summary Report, 1 Nov. 1961–31 Mar. 1962
M. A. Pichel 10 May 1962 152 p
(Contract NAS7-86)
(NASA-CR-57347; EOS-2100-IR-1) CFSTI: HC $5.00/MF $1.25

This program was chiefly concerned with investigation of backing and support structures for 5-foot diameter concentrators and the evaluation of parameters relative to their application to concentrators of larger sizes. Stress was on the design and structural approaches of electroforming and the application of this technique to the production of concentrators. Special tooling required for the fabrication of 5-foot diameter concentrators was designed and produced. A number of supporting and investigatory studies were carried on relative to the parameters affecting the electroforming of a variety of materials suitable for use in concentrator fabrication, with emphasis on electroformed nickel and copper. Testing of the physical properties of electroformed samples made under a wide range of conditions has been initiated and it appears that a relatively wide variation in physical properties can be obtained on a controlled basis. Various reflective and protective coatings have also been investigated for use with concentrators produced by the electroforming process, and their durability under various environmental conditions is being evaluated. Author

N65-19697*# Electro-Optical Systems, Inc., Pasadena, Calif. Engineering Development Dept.
RESEARCH AND DEVELOPMENT TECHNIQUES FOR FABRICATION OF LIGHTWEIGHT SOLAR CONCENTRATORS Addendum Report
M. A. Pichel 21 Dec. 1962 14 p
(Contract NAS7-86)
(NASA-CR-57346; EOS-2100, Addend.) CFSTI: HC $1.00/MF $0.50

Fabrication of a 5-ft diam copper concentrator was completed, and this unit together with a 5-ft diam nickel concentrator was coated with chromium, silicon, and aluminum layers. Calorimetric efficiency tests showed a higher efficiency for the copper concentrator with an average of 68% at the 1/2-in. orifice, as compared to the all-nickel concentrator with an average efficiency of 64.2%. It was concluded that modified design concepts for control of the edge effect and parting procedures will improve the concentrator efficiency. G.G.

N65-19723# Curtiss-Wright Corp., Wood-Ridge, N. J. Wright Aeronautical Div.
HIGH TEMPERATURE TURBINE COMPONENT DEVELOPMENT FOR TRECOM SMALL GAS TURBINE ENGINE PROGRAM Monthly Technical Report No. 9, Feb.–Mar. 1965
15 Mar. 1965 21 p
(Contract DA-44-177-AMC-182(T))
(WAD-R-419-9)

The alternate cast disk-welded attachment design appeared to provide some solutions to the split-disk, circumferential firtree configurations which have various disadvantages. The properties of several alloys were considered for the blade and disk material for which both the temperature–strength and weldability characteristics are of prime importance. Preliminary cooling-air orifice sizes were determined for both the rig stator and rotor blades. Fabrication of the cascade stator blades was completed, and airflow checks were made indicating that they have the required capacity. Welding techniques developed during the fabrication of the turbine stator blades are reviewed. E.E.B.

N65-19727# General Electric Co., Cincinnati, Ohio. Materials Development Lab.
THE DEVELOPMENT OF METHODS FOR THE ULTRASONIC INSPECTION OF BEARINGS Final Engineering Report, Mar. 1963–Sep. 1964
E. N. Bamberger and J. D. Marble 20 Oct. 1964 93 p refs
(Contract NOw-63-0383-d)
(AD-454013)

A program was conducted to develop and demonstrate feasibility of an ultrasonic inspection technique for antifriction bearings. The purpose of this type of nondestructive inspection is to increase the reliability of bearings by the elimination of those parts subject to premature failure. The special ultrasonic inspection technique coded MC_3 is particularly suited for bearing inspection, due to the ability to control its depth of scan, thereby restricting the inspected region. Using the MC_3 technique, the inner and outer raceways of 100 ball bearings were inspected prior to assembly. The inspection data were analyzed and the bearings ranked in order of probability of failure. Following testing, a reinspection was performed on a number of long-life, unfailed bearings to determine whether the MC_3 inspection could also detect incipient subsurface failures. The MC_3 inspection is capable of sorting out those bearings likely to fail in the early portion of life, although not yet on a completely reliable basis. Until the reliability can be more absolute, the MC_3 method cannot be recommended for immediate application as a quality control measure. Author

N65-19728# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
ELECTROMAGNETIC TEST CONTROL REQUIREMENTS
Patrick C. Mc Eleney and Rudolph V. Giangrande Sep. 1964 23 p refs
(ARMA-TR-64-26; AD-609438) CFSTI: $0.50

Three areas which require control in electromagnetic nondestructive testing are identified. The magnetic field strength of the test, magnetic history of the part, and heating of the test standard can and have seriously affected results in magnetic testing in critical programs. Experiments conducted indicate how these factors influence test results, and techniques are recommended whereby adequate procedures can be established. Author

N65-19771*# Marquardt Corp., Van Nuys, Calif.
THE EVALUATION OF A TIN-ALUMINIDE OXIDATION RESISTANT COATING FOR REACTION CONTROL SYSTEM THRUST SYSTEMS APPLICATIONS Final Report, 26 Jul. 1963–1 Aug. 1964
R. C. Miller 1 Aug. 1964 38 p
(Contract NAS9-1765)
(NASA-CR-57308; TMC-S-430) CFSTI: HC $2.00/MF $0.50

Rocket firing experiments were conducted with two designs of propellant injectors and two thrust chambers. The propellant injectors used included a design that resulted in nominal chamber wall temperatures in the 2800° F range and one which resulted in chamber wall temperatures in the 2300° F range. All tests were conducted under simulated altitude exhaust conditions of approximately 100 000 feet and propellants utilized were (50% UDMH/50% N_2H_4) and N_2O_4. Additional experimental efforts were conducted; the information obtained includes test results with a disilicide-coated tantalum chamber. The conclusion reached, based on rocket firing experiments, is that tin–aluminide-coated 90Ta-10W radiation-cooled rocket engines have an upper temperature operating limit higher than 2360° F but below 2750° F. Author

N65-19813# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.
AN ADJUSTABLE POSITIVE-LIMIT MAGNETIC TORQUE WRENCH
J. H. Walker Mar. 1965 17 p
(SC-TM-65-48) CFSTI: $1.00

This memorandum describes the design and test results on prototype torque wrenches which incorporate electromagnetics and permanent magnets to provide positive-limit torque output with no possibility of exceeding a present torque value. Author

N65-19839# Springfield Armory, Mass.
APPLICATION OF LAMB WAVES TO THE EXAMINATION OF STEEL STRIP FOR LAMINAR DEFECTS
H. P. Hatch and K. A. Fowler 12 Aug. 1964 21 p refs
(SA-TR19-1510; AD-455580)

A nondestructive method of detecting laminar defects in steel strip was developed. Lamb waves, generated in the strip by a wheel-type search unit, were utilized to provide 100% scanning of the 2.25-inch wide coiled strip. The test fixture and the auxiliary equipment, required for the test method, are described. Typical test indications are shown and discussed in terms of defect severity as determined by metallographic examination. Author

N65-19849*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
MATERIALS FOR POTASSIUM LUBRICATED JOURNAL BEARINGS Quarterly Progress Report No. 6, Jul. 22–Oct. 22, 1964
R. G. Frank, ed. [1964] 74 p refs
(Contract NAS3-2534)
(NASA-CR-54264) CFSTI: HC $3.00/MF $0.75

Twenty Cb–1Zr alloy capsule assemblies were filled with purified potassium and tested isothermally for 1000 hours at 800°, 1200° F, and 1600° F in a vacuum of 10^{-8} to 10^{-9} torr. Chemical analyses, by the mercury amalgamation method, of samples of the potassium taken at the same time that the capsules were filled, indicated the potassium contained less than 50 ppm oxygen. Each of the three sets of six capsules contained test specimens of K601, TiC, 10%Cb+TiC, 5%W+TiC, Grade 7178, and Star J materials. Two additional capsules, tested at 1600° F, contained specimens of 10%-Mo+TiC and TiB_2, respectively. The chamber pressure at the end of the test was 1×10^{-9} torr. To evaluate dimensional stability, duplicate specimens of 10 of the 14 candidate materials were tested for 1000 hours at 1200° and 1600° F in vacuum. The chamber pressure at the conclusion of the test was 1.3×10^{-9} torr. Of the 10 materials evaluated, the Zircoa 1027 was the only material to show a significant change in dimensions, i.e., approximately +0.4%, as a result of the 1000-hour exposure at 1600° F. Author

N65-19851*# Midwest Research Inst., Kansas City, Mo.
ADVANCED VALVE TECHNOLOGY
Kenneth D. May Washington, NASA, Feb. 1965 190 p refs
Sponsored by NASA
(NASA-SP-5019) CFSTI: HC $1.50/MF $1.25

The purpose of this book is to disseminate advanced valve technology throughout all branches of industry. To achieve this objective, it was necessary to (1) determine the present industrial state-of-the-art—this was accomplished by conducting interviews, a literature search, and discussions with application and systems engineers at NASA installations; (2) recognize new advances—valves which have qualified for newer missiles, advanced aircraft, and spacecraft usually represent improvements beyond the industrial state-of-the-art; and (3) report the new technology—when a considerable number of custom-made valves fall within a given category, the combined technical information in that category will often fall into a pattern and indicate new trends and approaches. New trends and techniques mentioned are concerned with leakage, materials, compatibility, contamination, wear, reliability, response time, repeatability, valve actuators, proportional flow control, heat transfer, high pressure and temperature, pressure surge protection, flutter and chatter, and unique designs and applications. R.W.H.

N65-19892*# Stainless Steel Products, Inc., Burbank, Calif. Engineering Dept.
BELLOWS, TUNNEL FUEL TANK Summary Report
Ray Collier 3 Feb. 1965 5p
(Contract NAS8-11583)
(NASA-CR-57451; SSP-2314) CFSTI: HC $1.00/MF $0.50

Correction of flange tolerance discrepancy, and completion of sample tests are reported. Previous test results and the included design analysis show that the collapsing characteristics of the bellows necks or end attachment sleeves have been maintained by capping the bellows necks over the end attachment flanges and allowing the end flanges to support the imposed load. E.P.V.

N65-19893* SKF Industries, Inc., King of Prussia, Pa. Research Lab.
BEARING LUBRICANT ENDURANCE CHARACTERISTICS AT HIGH SPEEDS AND HIGH TEMPERATURES Progress Report No. 9, Oct. 1–Dec. 31, 1964
C. J. Wachendorfer [1964] 43 p refs
(Contract NASw-492)
(NASA-CR-57445; AL65T002) CFSTI: HC $2.00/MF $0.50

Testing has continued with nine consumable electrode vacuum melted steel angular-contact ball bearings and three high-temperature lubricants, viz, a highly viscous ester base oil, a six-ring polyphenyl ether, and a viscous hydrocarbon, at speeds up to 45 000 rpm, mean temperatures up to 680° F and under 365 lbs thrust load. Checkout tests were conducted to determine the operating temperature of the rig and bearings when heated by internal heat generation only, at 45 000 rpm and to arrive at a suitable arrangement for external cooling. Author

N65-19942 Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics
SURFACE FAILURE OF BEARINGS AND OTHER ROLLING ELEMENTS
G. J. Moyar and JoDean Morrow Nov. 1964 107 p refs *Its* Eng. Expt. Sta. Bull. 468 Available from Illinois Univ.: $2.00

Two modes of surface failure in rolling elements, fatigue pitting and cumulative plastic deformation, are considered. Special attention is given to the development of rational methods of data correlation and to the elimination of size and configuration effects in standard laboratory, bench rig, and full-scale bearing tests. An examination of the complex loading cycle induced in the elements by the rolling action, and its significance with regard to the fatigue and cycle-dependent stress–strain material characteristics, is made for both phenomena. Included is a classification of research and an expanded literature review pertinent to these failures, as well as excessive rolling resistance. Emphasis is placed on the need for rolling contact tests in which forces and relative motions are known and controlled. Author

N65-19948# College of Aeronautics, Cranfield (England). Dept. of Production and Industrial Administration
CALCULATING THE SHEAR ANGLE IN ORTHOGONAL METAL CUTTING FROM FUNDAMENTAL STRESS-STRAIN-STRAIN RATE PROPERTIES OF THE WORK MATERIAL
P. L. B. Oxley and M. J. M. Welsh Mar. 1964 15 p refs Presented at 4th Intern. Machine Tool Design and Res. Conf., 1963
(COA-M&P-4)

An analysis of the orthogonal metal cutting process is made, which enables the shear angle to be calculated from certain fundamental properties of the work material and the specified cutting conditions. Shear angles are calculated for a range of cutting conditions and good agreement is shown between theory and experiment. In particular, such trends as the decrease in shear angle with decrease in cutting speed and the tendency for the chip to become discontinuous at slow cutting speeds which are found experimentally and cannot be explained in terms of previous shear angle analyses, are shown to be consistent with the present analysis. Author

N65-19949# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Materials Lab.
THE EFFECT OF CLEANING AND PAINT STRIPPING COMPOUNDS ON STRESSED HIGH STRENGTH STEEL
Lester S. Constantine 23 Jul. 1964 35 p refs
(NAEC-AML-1983; AD-443941)

Experiments were conducted to determine which of the selected cleaning and paint stripping materials used by the Navy might cause failure of stressed high-strength steel parts. Several alkaline paint strippers, one acid paint stripper (the only one tested), MIL-C-5410B acid-type aluminum cleaners, and MIL-C-5541 aluminum conversion coating material caused failure of high-strength steel specimens that was attributed to hydrogen embrittlement. Failures induced by MIL-C-18687 aircraft surface cleaners during immersion tests were considered to be due to stress corrosion. About one-half the paint stripping compounds and all but three of the cleaning and processing materials did not cause failure of notched C-ring specimens heat treated to the 230 000-psi strength level. Author

N65-19971# General Electric Co., Schenectady, N. Y. Advanced Technology Labs.
LUBRICATION OF HEAVILY LOADED, LOW VELOCITY BEARINGS AND GEARS OPERATING IN AEROSPACE ENVIRONMENTAL FACILITIES
Ralph E. Lee, Jr. Arnold AF Sta., Tenn., Arnold Eng. Develop. Center, Jan. 1965 212 p refs
(Contract AF 40(600)-1013)
(AEDC-TR-65-19; AD-456355)

This report presents the results of a balanced study of bearings and gears for heavily loaded, low velocity space simulator applications, integrated with a research effort directed toward the development of materials, lubricants, application processes, and evaluation and testing techniques. Solid film lubricants consisting of molybdenum disulfide and graphite with silicate and epoxy-type binders, and thin-film platings of gold and silver, were among the better performers. Molybdenum disulfide–glass, and graphite aluminum phosphate were among the more successful solid film lubricants developed. Apiezon L, a low vapor pressure petroleum distillate exhibited good performance characteristics. Lubricated cylindrical, spherical, ball, and tapered rolling element bearings of 30-, 50-, and 100-mm-bore sizes were tested in this effort. The gears tested were helical. Author

N65-19976# SKF Industries, Inc., King of Prussia, Pa. Research Lab.
A BASIC STUDY OF THE SLIDING CONTACTS IN ROLLING BEARINGS Progress Report No. 3, 17 Oct. 1964–16 Jan. 1965
C. J. Belsky, K. Tataiah, A. Elshinnawy, W. E. Schmidt, and J. B. Waltrich [1965] 76 p refs
(Contract NOw-64-0428-c)
(AL65L009; AD-611378)

A new technique was developed to process signals from the distance gage used in the measurement of the skew and axial position of rollers in cylindrical roller bearings. A small on-line computer was used to obtain average values of skew angles and axial positions of identified rollers, as well as overall averages for all the rollers in the bearing. This method was used in processing previously tape-recorded distance gage signals. Evaluation of the results showed two main causes for roller skew in the cylindrical roller bearing used in the tests: misalinement between the rolling paths of the inner and outer ring, and cage pocket misalinement. Instrumentation was set up for the simultaneous recording of roller skew data on two distance gages to determine the correlation between roller skew and axial motion. The feasibility of using on-line and digital computers in the processing of the signals was investigated. R.R.D.

N65-20025# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DEVELOPMENT OF METHODS AND INVESTIGATION OF MECHANICAL PROPERTIES OF GRAPHITES AND CARBIDES AT TEMPERATURE OF UP TO 3200°C
G. G. Konradi and M. A. Fedotov 2 Mar. 1965 13 p refs Transl. into ENGLISH from Tr. Vtorogo Nauchn.-Tekhn. Soveshch., Vopr. Vysokotemperaturnoy Prochnosti v Mashinostr., Akad. Nauk Ukr. SSR, Inst. Metallokeramiki i Spets. Splavov (Ukraine), 1962 p 50–57
(FTD-TT-64-1035/1+2; AD-611840)

A search of domestic and foreign literature data for the mechanical properties of graphites and carbides was made. A method for the examination of these properties is discussed, and its accuracy is evaluated. Listed are the properties of graphites in the temperature range from normal to 3200°C, and of carbides at high temperatures. Author

N65-20041# Metals and Controls, Inc., Attleboro, Mass.
STUDY OF DUCTILE COATINGS FOR THE OXIDATION PROTECTION OF COLUMBIUM AND MOLYBDENUM ALLOYS Final Report, 1 Jul. 1963–30 Jun. 1964

J. J. Buchinski and E. H. Girard. Oct. 1964 127 p refs
(Contract NOw-63-0706-c)
(AD-608135)

Platinum and Pt–10% Rh were examined as potential ductile oxidation-resistant coatings for FS-85 (Cb–28Ta–10W–1Zr) and TZM (Mo–0.5Ti–0.1Zr). Oxidation tests on coating materials showed that 2-mil thicknesses would provide over 100 hours of protection up to 3000° F in the absence of diffusion degradation. Roll-bonded and hermetically sealed binary composites were evaluated for oxidation and diffusion behavior. Coating lifetimes of 5 to 15 hours at 2550° F were attained before diffusion-induced failure occurred. No significant differences were observed between static and cyclic oxidation behavior. Failure mechanisms of FS-85 and TZM composites were shown to be substantially different from each other. Six materials were evaluated in screening tests for potential diffusion barriers. Only ZrO_2 showed any merit, while Re, Au, Al, BN and Al_2O_3 did not. Author

N65-20042# United Aircraft Corp., Windsor Locks, Conn. Hamilton Standard Div.
ELECTRON BEAM TECHNIQUES FOR FABRICATION AND ASSEMBLY OF PARTS FOR ELECTRON TUBES Phase II Report, 1 Jul. 1963–31 Aug. 1964
John F. Dudenhoefer [1964] 176 p refs
(Contract DA-36-039-AMC-03625(E))
(EBR-147; AD-611141)

In this report selection and modification of joints to be welded are discussed, definition of the welding facility is presented, and fabrication and performance testing of engineering sample tubes are reported. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N65-18624# Westinghouse Electric Corp., Baltimore, Md. Surface Div.
INVESTIGATION OF GAS IONIZATION PHENOMENON AT OPTICAL AND IR FREQUENCIES First Technical Documentary Report, 11 Feb.–11 Aug. 1964
L. C. Van Allen, A. V. Phelps, and R. W. Waynant Griffiss AFB, N. Y., RADC, Jan. 1965 58 p refs
(Contract AF 30(602)-3332)
(RADC-TDR-64-422; AD-610590)

Results of the first half of the program are summarized and the status at that point is given. The experimental laser system is described and the calibration and monitoring procedures are discussed. Breakdown time statistics and charge measurements obtained during this time are presented. The theoretical study results obtained to date in the areas of the nonlinear ionization initiation mechanisms and the extension of the microwave breakdown theory are discussed. A preliminary description of the breakdown process is given. Author

N65-18629# Philco Corp., Blue Bell, Pa. Philco Research Labs.
COHERENT OPTICAL PARAMETRIC TECHNIQUES Second Quarterly Report
C. Wang Griffiss AFB, N.Y., RADC, Dec. 1964 15 p
(Contract AF 30(602)-3364)
(RADC-TDR-64-434; AD-610624)

Angular dependence of incident radiation of ruby light to produce its second harmonic in ADP was measured. The expected angle of incidence for parametric amplification of 6328 Å light by this second harmonic was calculated, and a preliminary setup for this amplification was constructed. Author

N65-18885 Library of Congress, Washington, D. C. Aerospace Technology Div.
MULTICAVITY RADIOMETER MASERS FOR STUDIES OF THE 21-cm HYDROGEN LINE
S. G. Hibben *In its* Foreign Sci. Bull. Feb. 1965 p 1–6 refs
(See N65-18884 09-34)

A discussion is presented of the design and operation of two types of dual-cavity masers intended for recording 21-cm emission from galactic hydrogen. Results are described for a passive–active type and for a variant in which both cavities contain active ruby. The advantages in gain-bandwidth product and stability over the single-cavity maser are pointed out. The general case of a multicavity maser using active EPR material throughout is analyzed theoretically, and varying degrees of nonreciprocal coupling are examined. Author

N65-19166# Army Electronics Labs., Fort Monmouth, N. J. Solid State and Frequency Control Div.
EXPERIMENTS RELATING TO REGENERATIVE LASER AMPLIFIER DESIGN
H. Jacobs, J. Castro, F. A. Brand, C. Lo Cascio, and G. Novick (Monmouth Coll.) Dec. 1964 38 p refs
(ECOM-2531; AD-610111)

Experiments and calculations are reported in efforts to determine the applicability of multiple reflection concepts to laser amplifier design. The data indicate at least qualitative agreement with proposed theories in that if the regenerative amplifier is pumped with too much energy the amplification will decrease. Estimates of the population inversion of the amplifier show that as the pump light from the xenon source irradiates the ruby crystal, $/\alpha/$ increases in the amplifier before amplifier oscillations appear, during the period of oscillations, and even after the amplifier oscillations cease. However, as the time between the quenching of the oscillation of the amplifier and the arrival of the input signal increases, the gain decreases. This effect is consistent with the multiple reflection theory. Author

N65-19177# General Electric Co., Syracuse, N. Y. Heavy Military Electronics Dept.
SEMICONDUCTOR LASER ARRAY TECHNIQUES (SEMLAT) Second Quarterly Report
N. E. Collins, R. O. Grubel, C. S. Kim, H. Raillard, J. M. Smith et al Griffiss AFB, N.Y., RADC, Feb. 1965 51 p refs
(Contract AF 30(602)-3414)
(RADC-TR-64-548; AD-611829)

Materials evaluation, construction techniques, and preliminary testing of two-diode arrays are discussed. Considerations leading to specifications of the required cryogenic equipment for testing the ultimate diode array are presented. Testing of single diodes to obtain matched pairs and the appropriate test system to detect microwave beat frequencies are described. Thermal considerations leading to a proper selection of array diode spacing are presented. Author

N65-19528# Columbia Univ., New York. Columbia Radiation Lab.
THE OPTICAL MASER APPLIED TO BRILLOUIN SCATTERING SPECTROSCOPY Final Report, Oct. 1, 1962–Dec. 31, 1964

R. Novick Jan. 1965 15 p refs
(Grant DA-ARO(D)-31-124-G380)
(AROD-3922-13; AD-458654)

The successful observation of the spectral profile of the central Brillouin component is reported. The line shape was found to be quite closely fitted by a Lorentzian curve as predicted earlier. The temperature and angular dependence of the Lorentzian line were also successfully observed. Specific technical developments reported include the construction of a laser homodyne spectrometer, which comprises a laser light source, a divided optical path, the externally driven Bragg tanks, and the detection apparatus and associated data processing equipment, and the design and construction of a temperature control system capable of maintaining the scattering sample at a fixed known temperature to within ± 0.001° C. Three significant achievements are reported: the first observation of time-dependent concentration fluctuations in a binary mixture, the measurement of the size of minute colloidal particles with diameters less than 1000 Å, and the measurement of liquid flow rates to values as small as 0.004 cm/sec. D.E.W.

N65-19791# Case Inst. of Tech., Cleveland, Ohio.
LASERS AND LASER SPECTROSCOPY
W. B. Johnson [1964] 215 p refs Presented at the 3d Natl. Meeting of the Soc. for Appl. Spectry., 28 Sep.–2 Oct. 1964
(TR-A-34)

A general discussion of lasers and their applications to various spectroscopic problems is presented. Laser technology applicable to these problems is discussed, and methods are covered for modulating and demodulating light, for producing various laser transitions, for initiating the stimulated Raman effect, and for observing nonlinear optical phenomena. Detectors suitable for use in such experiments are considered, as are techniques for providing vernier frequency shifts. The application of these subjects to specific problems is discussed. Author

N65-20002# Raytheon Co., Waltham, Mass. Research Div.
GASEOUS LASER RESEARCH Interim Engineering Report No. 3, 1 Nov. 1964–31 Jan. 1965
F. Horrigan, S. Koozekanani, R. Paananen, and D. Warshauer [1965] 48 p refs
(Contract AF 33(615)-1949)
(S-740; AD-611831)

Emphasis was placed on spontaneous emission studies of level population dependences on gas pressure, discharge current, and tube diameter, and the laser power output was studied as a function of these parameters. Measurements of metastable densities via absorption studies were made, and the parameter change effects in the computer model of a discharge excited laser system were investigated. Results are presented and conclusions are drawn concerning the excitation mechanisms responsible for the laser action in pure xenon discharge excited laser systems. Author

N65-20038# Stanford Univ., Calif. Microwave Lab.
MICROWAVE RESEARCH Quarterly Status Report No. 23, 1 Aug.–31 Oct. 1964
M. Chodorow Dec. 1964 18 p refs
(Contract Nonr-225(48))
(ML-1277; AD-610667)

Eight projects in microwave research are described: (1) acoustic wave amplification—microwave region in piezoelectric semiconductors; (2) optical masers—extention and improvement of their performance for physical research problems; (3) diffraction of light waves by hypersound—search for crystals with stronger diffracting power; (4) transient effects in optical masers—control of buildup of laser oscillations; (5) electron-phonon interactions—electron scattering by acoustic phonons and relaxation time in n-type InSb, and design of a cryostat for ultrasonic attenuation in solids; (6) interaction of spin waves and electrons—parametric excitation of growing spin waves; (7) geometrical optics of acoustic waves—possibilities of an ultrasonic microscope, and focussing of acoustic waves in piezoelectric crystals; and (8) Raman scattering from birefringent crystals—development of a continuously tunable optical source utilizing Raman scattering from a birefringent crystal. R.W.H.

N65-20072# Kollsman Instrument Corp., Elmhurst, N. Y.
LASER OPTICAL ALIGNMENT SYSTEM
1 Feb. 1965 10 p
(LOPALS-1)

The design specifications are presented for an optical theodolite employing a laser system as the self-contained pulsed light source, and using photomultiplier tubes in the optical nulling feedback loops to automatically obtain the desired information. The theodolite axes are alined in the standard manner, and the detection technique is particularly reliable with regard to fog and heat shimmer. After setup the instrument operates automatically, continuously accumulating data on target motion. The all-weather design range is at least 1000 ft. E.P.V.

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N65-18636# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN CHARACTERISTICS OF WELDING TITANIUM UNDER FLUX
S. M. Gurevich 29 Mar. 1963 18 p refs Transl. into ENGLISH from Avtomat. Svarka (Kiev), no. 5, 1957 p 38–48
(FTD-TT-63-22/1 + 2; AD-402468)

Metallurgical and technological characteristics of the automatic welding of titanium under flux are discussed. It is concluded that the flux for welding titanium should be oxygen-free and should have a sufficiently high melting point. One of the important metallurgical features of welding titanium under flux is the reaction between flux slag and the metal. Specifically, the recovery of sodium from sodium fluoride is possible through the interchange reactions between titanium oxide and fluorides in the flux. Because of its low specific weight, the melting of titanium is 1.5 to 2 times more extensive than that of steel under similar conditions, but, because of its low thermal conductivity, the quenching rate and hot time of metal near the seam are much less in titanium than in steel. D.E.W.

N65-18640# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINMENT AND PROPERTIES OF MONOCRYSTALS OF THE HIGH-MELTING METALS, TUNGSTEN, RHENIUM, TANTALUM, MOLYBDENUM AND NIOBIUM

Ye. M. Savitskiy, Ch. V. Kopetskiy et al 6 May 1963 6 p Transl. into ENGLISH from the book "Issledovaniya Po Zharprochnym Splavam", v. 9 (Moscow), Akad. Nauk SSSR Inst. Met., 1962 p 192–194
(FTD-TT-63-270/1+2; AD-409270)

Zonal electron beam fusion of high melting point metals for purification and monocrystallization was investigated in a high vacuum chamber of up to $3 \cdot 10^{-6}$-mm mercury at a pumping rate of 3000 liters/minute. The shifting speed of the loop-shaped tungsten wire or tantalum foil cathode in relation to the inserted specimen rod was regulated by an electric motor in the limits of 8 to 60 cm/hr. A graphic illustration of the electric circuit of the unit is presented. Rods obtained after the fusion were etched and on each of them appeared faces of crystals. Hardness values measured on the transverse sections of the monocrystals were niobium—79, molybdenum—170, tantalum—75, rhenium—154, and tungsten—345 kg/cm^2. Extension tests of monocrystals of molybdenum, niobium, and tantalum showed cross-section contraction of about 100%. G.G.

N65-18643# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF A HYSTERESIS LOOP OF COBALT-NICKEL FERRITES
T. I. Bulgakova and L. S. Guzey 13 Jun. 1963 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. II; Khim. (Moscow), no. 6, 1962 p 58–60
(FTD-TT-63-448/1+2+4; AD-409148)

An investigation was carried out of the influence of the composition, temperature, and thermomagnetic treatment on the form of a hysteresis loop of the class of ferrites, $Co_x Ni_{1-x}Fe_2O_4$. It was established that after a specific heat treatment the ferrites have contracted loops when x is between 0.3 and 0.6. It was found that thermomagnetic treatment changes the form of the loop, tending toward an appearance of induced rectangularity. D.E.W.

N65-18657# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF ALLOYING ON THE HARDNESS OF NiAl AND ITS SOLID SOLUTIONS
L. A. Kucherenko, V. A. Troshkina, and K. B. Khomyakov 22 Dec. 1964 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. II: Khim. (Moscow), no. 1, 1964 p 53–55
(FTD-TT-64-1270/1+2; AD-609783)

The influence of small amounts of added Mn, Fe, Co, and Cu on the hardness of the stoichiometric compound NiAl and defective structures containing excess aluminum or nickel in solid solution was studied. The compositions of the alloys were investigated, and the additives in the β-solid solution were introduced from a computation of the replacement of insufficient amounts of aluminum or nickel as compared with the NiAl of stoichiometric composition. Hardness was measured on annealed specimens after tempering at temperatures from 500° to 800° C. The influence of the additives shows up only in the grain size of the solid solution. The solid solutions of the additives are characterized by lower values for hardness than those of the compound NiAl. E.P.V.

N65-18683# Rutgers Univ., New Brunswick, N. J. Coll. of Engineering
FINE STRUCTURE OF METALS Final Report
S. Weissmann 1 Dec. 1964 4 p refs
(Contract Nonr-404(09))
(AD-608748)

A combination method was developed for the study of the defect structure of solids. It consists of a quantitative analysis of the stress–strain configuration in single crystals based on the strain data supplied by the X-ray divergent beam method, followed by a visual inspection of the defect structure by transmission electron microscopy. In an extension of the stress–strain analysis, the stored elastic energy as well as the maximum shearing strains in any desired crystallographic set of planes was also obtained. Aided by a digital computer, this combination method was applied to a number of problems in physical metallurgy and solid state physics. In a study of recovery and recrystallization of metals, the existence of a long-range strain field was shown to be associated with the dislocation structure of very small asymmetrical low-angle boundaries and dislocation tangles. The combination method was also applied to the ordering process in the copper–gold system subjected to low ordering temperatures, and to the effect of low-temperature anneal in copper-base aluminum alloys with low stacking-fault energy γ. In analogy to the strains set up by the ordering of CuAu crystals, the strain configuration induced by a magnetic field was also studied. R.L.K.

N65-18691# Battelle Memorial Inst., Columbus, Ohio. Metals and Ceramics Div.
STUDY OF LOCAL-ORDER AND SOLID-SOLUTION STRENGTHENING IN COLUMBIUM ALLOYS, PART II Technical Documentary Report, May 1, 1963–Apr. 30, 1964
P. S. Rudman Wright-Patterson AFB, Ohio, AF Mater. Lab., 22 Jan. 1965 37 p refs
(Contract AF 33(657)-8844)
(ASD-TDR-63-567, Pt. II; AD-610468)

This research program attempted to establish whether Fisher's local-order solution-stengthening mechanism is of importance in columbium-base alloys by correlating X-ray diffuse-scattering determinations of local order with mechanical properties. Results of the project indicated that local order can make a significant strengthening contribution, but other mechanisms can also dominate. By X-ray diffuse-scattering powder-pattern analysis, it has been determined that Cb-V alloys are nearly random. The atom-size effect was also determined. Solid-solution strengthening due to atom-size difference in a substitutional binary alloy is shown to depend on composition fluctuations. An elastic model of binary solid solutions is extended to include short-range order (SRO) strain relaxation. It is shown that typically about half of the atom dilation and strain energy can be relaxed by SRO. The calculation predicts that SRO should reduce deviations from Vegard's law, and this is as has been found in the Cu–Au system. Author

N65-18701# Joint Publications Research Service, Washington, D. C.
PROBLEMS OF THE THEORY AND USE OF RARE EARTH METALS
Ye. M. Savitskiy and V. F. Terekhova, ed. 23 Feb. 1965 370 p refs Transl. into ENGLISH of "Voprosy Teorii i Primeneniya Redkozemel'nykh Metallov" Moscow, "Science" Publishing House, 1964 p 1–271
(JPRS-28849; TT-65-30372) CFSTI: $7.00

Contains papers on physical properties, phase diagrams and crystal structures, and production uses of rare earth metals and alloys. For individual titles see N65-18702–N65-18747.

N65-18702 Joint Publications Research Service, Washington, D. C.
STATE AND PROBLEMS OF INVESTIGATIONS OF ALLOYS OF THE RARE EARTH METALS

Ye. M. Savitskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 1–10 refs (See N65-18701 09-17) CFSTI: $7.00

A brief account of recent metallurgy and industrial applications of rare earth metals (REM) is presented. Particular attention is given to Russian accomplishments in this field, and to Russian organization for future work. Specific needs for REM research discussed include studies of properties of pure REM, structure and properties of REM alloys, economics of industrial uses of REM, and search for new REM alloys with special properties. J.M.D.

N65-18703 Joint Publications Research Service, Washington, D. C.

WHAT'S NEW IN THE PRODUCTION AND USE OF THE RARE EARTH METALS

B. I. Kogan *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 11–30 refs (See N65-18701 09-17) CFSTI: $7.00

Developments in metallurgy and industrial applications of rare earth metals (REM) since 1959 are discussed. Specific areas of discussion are raw material resources, mining and production, REM consumption in the United States, and REM prices in the United States, and applications of REM. A bibliography of 64 publications on REM is given. J.M.D.

N65-18704 Joint Publications Research Service, Washington, D. C.

DEVELOPMENT OF STUDIES OF THE RARE EARTH METALS AND ALLOYS IN THE INSTITUTE OF METALLURGY IMENI A. A. BAYKOV

V. F. Terekhova *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 31–46 refs (See N65-18701 09-17) CFSTI: $7.00

Properties of rare earth metals (REM), their interactions with other elements, and their effects in modifying iron are discussed. Vacuum distillation and zone refinement by electron-beam melting were compared for production of pure REM; distillation was found to be better. Interactions of REM with elements of various groups of the periodic table were studied in phase diagrams. Influences of yttrium and cerium on the structure and properties of cast iron were compared, and no great difference was seen. J.M.D.

N65-18705 Joint Publications Research Service, Washington, D. C.

FERROMAGNETISM AND ANTIFERROMAGNETISM OF RARE EARTH METALS AND ALLOYS

K. P. Belov and R. Z. Levitin *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 47–63 refs (See N65-18701 09-17) CFSTI: $7.00

A survey of data on magnetic properties of rare earth metals (REM) and their alloys is presented. Temperature dependence of magnetization of single crystals in the yttrium subgroup is reviewed; the same property is discussed for REM alloys with iron-group elements, and with aluminum, manganese, and elements of the platinum group. Susceptibility to passing into the antiferromagnetic state is reported for elements of the cerium subgroup. J.M.D.

N65-18706 Joint Publications Research Service, Washington, D. C.

MAGNETIC PROPERTIES OF ALLOYS OF GADOLINIUM WITH IRON, CERIUM, AND YTTRIUM

V. I. Chechernikov, I. Pop, and I. V. Burov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 64–70 refs (See N65-18701 09-17) CFSTI: $7.00

Data on temperature dependence of the relative specific magnetization in alloys of gadolinium with iron, cerium, and yttrium are presented. The curves extend from the temperature of liquid nitrogen to the melting points of the alloys. Additional work shows that antiferromagnetic exchange interaction exists in these alloys. The Gd–Fe alloys with varying percentages of atomic Gd evidently possess a sublattice magnetic structure. In Gd–Ce alloys the presence of a helicoidal or more complex spin configuration is considered possible in conjunction with magnetic sublattices. The behavior of Gd–Fe and Gd–Y alloys in the paramagnetic region is apparently determined chiefly by a Curie–Weiss paramagnetism. J.M.D.

N65-18708 Joint Publications Research Service, Washington, D. C.

MAGNETIC PROPERTIES OF MONO- AND POLYCRYSTALLINE SCANDIUM

V. I. Chechernikov, I. Pop, and O. P. Naumkin *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 81–85 refs (See N65-18701 09-17) CFSTI: $7.00

Temperature dependence of $1/\chi$, the reciprocal of the specific susceptibility, is shown for polycrystalline scandium samples of various purities. In all samples, the relationship of $1/\chi$ to temperature (T) is clearly linear and positive; the slope increases with increasing purity of sample. The magnetic moment, P_p, is obtained by using the Curie–Weiss law, $\chi = C/(T - \Theta_p)$, where C is a constant and Θ_p is the paramagnetic Curie point. Data show the P_p decreases with increasing sample purity; Θ_p also increases but is negative for all samples. Single crystal temperature dependence is also demonstrated to be linear. J.M.D.

N65-18709 Joint Publications Research Service, Washington, D. C.

INVESTIGATION OF THE PROPERTIES OF METALLIC SCANDIUM

O. P. Naumkin, V. F. Terekhova, and Ye. M. Savitskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 86–97 refs (See N65-18701 09-17) CFSTI: $7.00

Basic physicochemical properties of scandium were determined on samples of various purities. It was found that mechanical workability of scandium depends largely on its purity. Oxidizability of thin films of scandium was studied by electron diffraction, and the protective properties of the oxide film were investigated. Kinetic curves are presented for oxidation in massive samples of scandium subjected to various temperatures. Data on temperature dependence of scandium oxidizability are shown. Also, dependence of oxidizability on atomic number was studied for 17 rare earth metals. J.M.D.

N65-18710 Joint Publications Research Service, Washington, D. C.

TEMPERATURE DEPENDENCE OF THE ELECTRICAL AND GALVANOMAGNETIC PROPERTIES OF THE RARE EARTH METALS

N. V. Volkenshteyn, G. V. Fedorov, E. V. Galoshina, and V. Ye. Startsev *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 98–107 refs (See N65-18701 09-17) CFSTI: $7.00

In study of rare earth metals, the temperature dependence of the Hall electromotive force was measured at varied induction values for holmium, dysprosium, and erbium. Temperature dependence was also investigated for specific electrical resistance and magnetic susceptibility in scandium and various rare earth metals, and for the Hall coefficient in europium. J.M.D.

N65-18711 Joint Publications Research Service, Washington, D. C.

RARE EARTH METALS AND THEIR COMPOUNDS AS MATERIALS OF THERMOELECTRONIC CATHODES

B. V. Bondarenko and B. M. Tsarev *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 108–116 refs (See N65-18701 09-17) CFSTI: $7.00

Physical properties of various rare earth metals (REM) were studied to determine their usefulness as cathodes with working temperatures in the range 1150° to 1800° K; they were found to be unsuitable because of low melting temperatures. Other data are given on emission properties of film cathodes with REM films on refractory metals, thermoelectric properties of oxides of lanthanum and various REM, and secondary emission of various REM oxides. It is suggested that binary and more complex REM hexaborides, possessing higher specific electric resistance, could be used in developing cathodes of wide applicability. J.M.D.

N65-18714 Joint Publications Research Service, Washington, D. C.

METALLOGRAPHY OF SCANDIUM

O. P. Naumkin and V. F. Terekhova *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 143–147 refs (See N65-18701 09-17) CFSTI: $7.00

Photographic data are presented on the inclusions and impurities in metallic scandium of various degrees of purity. The microstructure of calcium–thermal scandium, scandium oxides, pure distilled scandium, and scandium photographed in polarized light, are shown. Grain boundaries and the distribution of impurities and inclusions are discussed. J.M.D.

N65-18715 Joint Publications Research Service, Washington, D. C.

PHASE DIAGRAMS WITH THE PARTICIPATION OF GADOLINIUM

I. V. Burov, V. F. Terekhova, and Ye. M. Savitskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 148–158 refs (See N65-18701 09-17) CFSTI: $7.00

Phase diagrams are presented for compounds of gadolinium with magnesium, cerium, iron, and cobalt. Microstructural, thermal, X-ray, dilatometric, magnetic, and hardness data were used in constructing the diagrams. On the basis of these studies, the following principles of the alloying behavior of gadolinium are established: (1) Gadolinium forms broad regions of solid solutions only with rare earth metals. (2) Liquid gadolinium forms broad regions of immiscibility with a number of elements, including sodium, calcium, vanadium, niobium, tantalum, and uranium. (3) In most cases gadolinium does not form chemical compounds with elements in periodic subgroups IA and VIA. Tabulated data show that lanthanum, cerium, and gadolinium are not equivalent in their alloying behavior with one another and with other nonrare earth metals. Since these analogs differ only in the number of 4f-electrons, it is concluded that the 4f-electrons exert an appreciable influence on the type of phase diagram in the formation of metallic alloys. M.P.G.

N65-18716 Joint Publications Research Service, Washington, D. C.

YTTRIUM AND PROSPECTS FOR ITS UTILIZATION

I. A. Markova, V. F. Terekhova, and Ye. M. Savitskiy *In its* Probl. of the Theory and use of Rare Earth Metals 23 Feb. 1965 p 158–165 refs (See N65-18701 09-17) CFSTI: $7.00

Physicochemical properties and binary phase diagrams of yttrium are presented and analyzed for indications of future applications. Immiscibility is evident in the phase diagrams of yttrium with the metals of subgroups IA, IIA, and VA, as well as chromium and uranium; eutectic-type diagrams are obtained with titanium, zirconium, hafnium, molybdenum, and tungsten; solid solutions are obtained only with rare earth metals, scandium, and thorium. The properties of yttrium and its alloys indicate applications as an alloying additive to increase heat resistance and improve mechanical properties of alloys, as a refining agent for vanadium and niobium, and to reduce nitrogen diffusion in chromium. Since yttrium does not react with liquid uranium and plutonium, it is being used in reactor construction. Yttrium hydride is a highly efficient moderator in core reactors, and yttrium oxide is used as a diluent for oxide fuel elements. Yttrium–iron ferrite garnets combine semiconductor, dielectric, and ferromagnetic properties with low electric resistance and low loss characteristics. Yttrium compounds may also be useful as superconductors and semiconductors. M.P.G.

N65-18717 Joint Publications Research Service, Washington, D. C.

INTERACTION OF VANADIUM WITH RARE EARTH METALS

Yu. M. Efimov, V. V. Baron, and Ye. M. Savitskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 166–178 refs (See N65-18701 09-17) CFSTI: $7.00

A review of phase diagrams and reported experimental data indicates that reactions of vanadium with rare earth metals, yttrium, and scandium are of the monotectic type, with broad regions of immiscibility. No metallic compounds are formed, and the solubilities do not exceed tenths of a percent. The rare earth metals, yttrium, and scandium are effective deoxidants and desulfurators of vanadium. Vanadium can be refined by arc melting with metallic cerium, which reduces the oxygen and nitrogen impurities and improves vanadium plasticity in the cold state. A considerable degree of desulfuration is also achieved by this process, but carbon and metallic impurities remain unchanged. The cerium content in cerium-refined vanadium does not exceed 0.1% by weight. M.P.G.

N65-18722 Joint Publications Research Service, Washington, D. C.

X-RAY DIFFRACTION STUDY OF ALLOYS OF RARE EARTH METALS AND YTTRIUM WITH BERYLLIUM

Ye. I. Gladyshevskiy, P. I. Kripyakevich, and D. P. Frankevich *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 195–196 refs (See N65-18701 09-17) CFSTI: $7.00

Beryllium-rich alloys of beryllium with all the rare earth metals except promethium and gadolinium were prepared and studied by X-ray diffraction. In each of the systems, a compound of the $NaZn_{13}$ type was found. Values obtained for the lattice constants are tabulated. In crystals of the beryllides, the cerium atoms tended to form R^{+4} ions whereas the atoms of europium and ytterbium tended to form R^{+3} ions. This is in contrast to the behavior of these atoms in magnesium, aluminum, silicon, and germanium compounds, in which cerium forms R^{+3} ions and europium and ytterbium form R^{+2} ions. M.P.G.

N65-18723 Joint Publications Research Service, Washington, D. C.

CRYSTAL STRUCTURES OF COMPOUNDS IN THE CERIUM-MANGANESE-COPPER-ALUMINUM SYSTEM AND IN THE TERNARY SYSTEMS THAT COMPRISE IT

Ye. Ye. Cherkashin, O. S. Zarechnyuk, P. I. Kripyakevich, and I. F. Kolobnev *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 197–198 refs (See N65-18701 09-17) CFSTI: $7.00

The quaternary system Ce–Mn–Cu–Al was studied in the aluminum-rich range to determine what phases exist in equilibrium with the α-phase. The X-ray analysis shows that, in addition to the binary compounds $MnAl_6$, $CeAl_4$, $CuAl_2$, and the triple compounds $CeMn_4Al_8$ and $CeCu_4Al_8$, two quaternary compounds exist in equilibrium with the solid solution based on aluminum. On the basis of line intensity patterns, one of the quaternary compounds has been assigned the formula $Ce(Mn,Cu,Al)_{11}$. M.P.G.

N65-18724 Joint Publications Research Service, Washington, D. C.

BINARY COMPOUNDS OF SCANDIUM WITH TRANSITION METALS AND BERYLLIUM

Ye. I. Gladyshevskiy, P. I. Kripyakevich, Yu. B. Kuz'ma, and V. S. Protasov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 199–200 refs (See N65-18701 09-17) CFSTI: $7.00

Alloys of scandium with Mn, Fe, Co, Ni, Cu, and Re were prepared and analyzed by X-ray diffraction. The structures of the various alloys formed are discussed in detail. In general, these scandium systems formed compounds of the same compositions and structural types as those formed in zirconium and hafnium systems. This is attributed to the close values of the atomic radii of scandium, zirconium, and hafnium. M.P.G.

N65-18725 Joint Publications Research Service, Washington, D. C.

PHASE DIAGRAM OF THE La_2O_3–MgO SYSTEM

S. G. Tresvyatskiy and L. M. Lopato *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 201–206 refs (See N65-18701 09-17) CFSTI: $7.00

A phase diagram of the La_2O_3–MgO system was constructed and compared with a fusibility curve for the system published by Wartenberg and Eckhardt. A compound of the spinel type, $MgO{\cdot}La_2O_3$, and two eutectics had been deduced from the fusibility curve, but the existence of this compound was not confirmed in the present work. The La_2O_3–MgO system is eutectic, with coordinates of the eutectic point equal to 52 mole% La_2O_3 and 48 mole% MgO. The melting point of the eutectic is 2000° ±20° C. These experimental results are in good agreement with data calculated by the method of Epstein and Howland. M.P.G.

N65-18734 Joint Publications Research Service, Washington, D. C.

NONMETALLIC INCLUSIONS IN STEELS WITH ADDITIONS OF RARE EARTH METALS

Yu. I. Rubenchik, Yu. V. Kryakovskiy, Ye. I. Tyurin, Ye. P. Ponomareva, A. F. Vishkarev et al *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 264–271 refs (See N65-18701 09-17) CFSTI: $7.00

The chemical and physical properties of inclusions in laboratory and open hearth melts were studied. Additions of cerium and lanthanum in the laboratory melts showed the formation of sulfides and oxysulfides of the rare earth metals from reaction with corresponding iron compounds. This change in the nature of basic inclusions was also established in the industrial melts of three industrial steels. The chemical and physical properties and compositions of the inclusions were determined and compared for ingot, cast, and rolled samples. The combination of low hardness with low plasticity is commonly specific to rare earth metal (REM) inclusions for all the basic materials and forms studied. Mechanical treatment had little or no effect on the character of the inclusions, although some changes in distribution were noted in rolled samples. E.P.V.

N65-18735 Joint Publications Research Service, Washington, D. C.

DEOXIDATION OF STEEL WITH LANTHANUM, CERIUM, PRASEODYMIUM, AND NEODYMIUM

G. Kinne, A. F. Vishkarev, Yu. V. Kryakovskiy, and V. I. Yavoyskiy *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 272–278 refs (See N65-18701 09-17) CFSTI: $7.00

Thermodynamic calculations were made to establish deoxidation equilibrium constants for lanthanum, cerium, praseodymium, and neodymium in liquid iron, at steel-smelting temperatures. The formation of cerium oxides was assumed to be temperature dependent, as well as primarily affected by dissolved oxygen content and the presence of weak or strong oxides of light metals, refractory metals, or silicon. The other three oxides were found to take the form REM_2O_3. Temperature dependence equations were determined by the indirect method, from Al_2O_3 crucible melts. E.P.V.

N65-18737 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF RARE EARTH METALS AND THEIR OXIDES ON THE PLASTICITY AND ANTICORROSION PROPERTIES OF STAINLESS STEELS

Ye. M. Savitskiy, V. F. Popov, N. V. Keys, and V. N. Lyubimov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 286–291 refs (See N65-18701 09-17) CFSTI: $7.00

In case of aftercharging of REM in stainless steels in amounts of 0.05%–0.18% or of oxides of REM in amounts of 0.08%–0.12%, the technological properties of the steels are sharply improved; the surface of the ingot of steels with an addition of REM is improved on account of better fluidity; the deformability of the steels is improved, the rough cracks along the angles and edges of the blanks are eliminated, and expenditures for their cleaning during reductions are reduced by 30%–40%. The macrostructure and anticorrosion properties are improved to a considerable degree on account of purification of the grain boundaries. In the case of additions of REM and REM oxides, the strength and plasticity increase, and the anisotropy of the chemical properties of the steel is reduced. In the case of additions of REM or REM oxides, the number of twists of samples of stainless steels before breaking at 1200° increases from 10 to 24 and from 13 to 23 revolutions, respectively. Author

N65-18738 Joint Publications Research Service, Washington, D. C.

DISTRIBUTION OF LEAD AND CERIUM IN IRON, NICKEL, AUSTENITE STEEL, AND THE NICKEL ALLOY EI765

M. V. Pikunov, A. S. Petukhova, L. A. Voskresenskaya, and I. P. Izotova *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 292–298 (See N65-18701 09-17) CFSTI: $7.00

Additions of cerium exert practically no influence on the distribution of lead in austenite steel; lead is distributed more uniformly in iron under the influence of additions of cerium. Additions of cerium introduce definite changes into the character of the solidification of the alloy EI765 containing an admixture of lead; after annealing, the inclusions enriched in cerium and lead do not dissolve, as was the case of inclusions of cerium alone or lead alone. It may be assumed that additions of cerium would displace the composition of the alloy into the region where crystallization ends in solidification of the eutectic containing not lead, but some complex compound of lead with cerium and perhaps nickel. Author

N65-18739 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF THE RARE EARTH METALS ON THE STRUCTURE AND PROPERTIES OF CONSTRUCTION STEELS

Ye. M. Savitskiy, V. F. Popov, and N. V. Keys *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 297–302 refs (See N65-18701 09-17) CFSTI: $7.00

In the treatment of construction steels 18KhNVA, 30KhGSA, and 12Kh2N4A with rare-earth metals (REM) in amounts of 0.1–0.28%, the following were established. When REM are added to the liquid steel in the ladle or in the casting mold, the sulfur content is reduced by 20%–30%. The macrostructure of the ingot is improved; the grain is pulverized. The mechanical properties of cast steel are improved to a greater degree than the mechanical properties of rolled steel. The most effective action of REM was detected on steel 18KhNVA, the strength, plasticity, and impact ductility of which were increased by 12%, 15%, and 4%, respectively. A negative effect of the REM in the steels studied was the unfavorable form of distribution of complex nonmetallic phases of REM, which produced an increase in the rating according to macrostructure. Author

N65-18740 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF RARE EARTH METALS ON THE STRUCTURE AND PHYSICAL PROPERTIES OF TECHNICAL IRON, NICKEL, AND COBALT

V. P. Taratynov, O. P. Yelyutin, and I. N. Gerasimova *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 303–309 refs (See N65-18701 09-17) CFSTI: $7.00

In the case of a small weight of the melts, the introduction of additions of neodymium in the form of its master alloy within the liquid metal in an open induction furnace provides for the most complete purification of iron from impurities and nonmetallic inclusions. The introduction of additions of neodymium into the casting mold or ladle in the case of a small weight of the melt leads to contamination of the metal by the reaction products of neodymium with the impurities. Additions of cerium, lanthanum, neodymium, praseodymium, and yttrium, within their solubility limits in the solid state, promote purification of technical iron, nickel, and cobalt from certain harmful impurities and nonmetallic inclusions, influence the grain size of thermally processed metal, improve the mechanical and in a number of cases the electrical and magnetic properties. Author

N65-18741 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF RARE EARTH METALS ON THE PLASTICITY AND STRUCTURE OF STAINLESS STEELS

N. F. Nakonechnyy and K. K. Prokhorenko *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 310–318 refs (See N65-18701 09-17) CFSTI: $7.00

Cerium, added in amounts of 0.2%–0.3% to steels 07Kh25N13 and 10Kh16N25M6, makes it possible to increase their plasticity at temperatures of 1000°–1250°. A cerium consumption of 0.2%–0.3% promotes a certain pulverization of the equiaxial crystals in the corresponding zone of the ingots. When the additions of cerium are further increased, the structure of the ingots returns to the initial type. The increase in the plasticity of steels 07Kh25N13 and 10Kh16N25M6 upon the introduction of 0.2%–0.3% cerium probably occurs as a result of the fact that cerium changes the distribution of the microchemical inhomogeneity in the steel and reduces its content of nonmetallic inclusions. Author

N65-18742 Joint Publications Research Service, Washington, D. C.

INFLUENCE OF RARE EARTH METALS ON SOME PROPERTIES OF AUSTENITE CHROMIUM-NICKEL STEELS

N. S. Kreshchanovskiy, M. F. Sidorenko, and A. S. Trekalo *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 319–325 refs (See N65-18701 09-17) CFSTI: $7.00

Cerium exerts a positive influence on the plastic properties, impact ductility, and weldability of cast, highly alloyed steel of brand Kh15N25M3V3TYu. An effective action on these properties is exerted when 0.5%–0.1% cerium is added. Cerium promotes coagulation and redistribution of the strengthening phases; it purifies the steel of nonmetallic inclusions, reducing their content three- to fourfold. As a result of cold plastic deformation of steel, cavities arise around cerium oxides, which increase with increasing degree of deformation. In the case of hot plastic deformation, cavities are detected both around the oxides and around the sulfides. Cerium should be introduced into preliminarily well deoxidized metal to reduce the content of cerium oxides in the smelting of steels. Cerium exerts a great influence on the distribution of dislocations in cast iron and promotes the formation of a dislocation network within the grains. Yttrium and lanthanum substantially improve the plasticity and impact ductility of steel. Author

N65-18743 Joint Publications Research Service, Washington, D. C.

USE OF A CERIUM MODIFIER FOR THE PRODUCTION OF HIGH-STRENGTH CAST IRON

S. S. Zatulovskiy, Ye. M. Nosova, E. S. Krylov, and A. A. Gorshkov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 326–332 refs (See N65-18701 09-17) CFSTI: $7.00

Research results are compared with subsequent industrial experience. The factor deciding the form of graphite in cerium cast iron, as well as the mechanical properties of the cast iron itself, is the carbon equivalent. The most promising technological change is the production of cerium cast iron globular graphite inclusions by melting in a cupola furnace with a basic lining, which is economically superior to similar magnesium cast iron production or acid-electric furnace smelting. E.P.V.

N65-18744 Joint Publications Research Service, Washington, D. C.

MICRODIFFUSION OF CERIUM AND ITS INFLUENCE ON THE DIFFUSION PARAMETERS AND STRUCTURE OF IRON-CARBON ALLOYS

G. N. Bakakin, A. P. Lyubchenko, M. V. Mozharov, and D. G. Sherman *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 333–341 refs (See N65-18701 09-17) CFSTI: $7.00

The investigated cast irons were smelted in a vacuum furnace by remelting gray cast iron with laminar graphite. The iron was modified in the liquid state with cerium, containing radioactive isotopes of Ce when required for analysis, and cooled at different rates. To determine the diffusion paths of cerium in iron and cast irons, hermetically sealed ampoules of the test material containing radiocerium were subjected to diffusion annealing, and then to radiometry or radioautography. Results show that the diffusion parameters of iron–carbon alloys are practically unchanged in the comparison with pure iron, when up to 0.5 wt% cerium is introduced. With increasing temperature, the predominantly boundary-type character of the self-diffusion of iron is converted gradually to a volume character. The interplane distances of the crystal lattice of graphite, mechanically isolated from Mg and Ce cast iron, are

not changed in comparison with the laminar graphite of unmodified gray cast iron. Hence, the contribution of the zone of perturbation (with a changed lattice) to the general interference picture of the X-ray reflection from graphite is extremely small. E.P.V.

N65-18745 Joint Publications Research Service, Washington, D. C.
INVESTIGATION OF THE INFLUENCE OF RARE EARTH METALS ON THE THERMAL STABILITY OF CARBIDES IN CAST IRON
N. A. Sidorov and E. M. Shkol'nikov *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 342-350 ref (See N65-18701 09-17) CFSTI: $7.00

The influence of the rare earth components of the cerium master alloy (cerium, lanthanum, neodymium, praseodymium) on the stabilization of the carbides and the formation of graphite in eutectic cast iron was investigated. It was found that stabilization of the carbides is achieved by the introduction and assimilation of a definite amount of the modifier, which comprises approximately 0.02% to 0.03% for cerium. To achieve the same effect using lanthanum, neodymium and praseodymium, it is necessary to introduce each of them in an amount of 0.6% to 0.8%, as against 0.1% to 0.2% Ce. The introduction of modifiers below this optimum amount reduced the ability of the cast iron for bleaching. When 0.4% lanthanum or less is introduced, a sharp increase in the graphitization of the cast iron during solidification is observed, in addition to a change in the form of the graphite. It was established that the comparative thermal stability of the carbides of cerium and lanthanum cast irons is close to the thermal stability of magnesium cast iron. When the residual cerium content is increased from 0.06% to 0.40%, the time of complete decomposition of the carbides is unchanged. Author

N65-18747 Joint Publications Research Service, Washington, D. C.
PRODUCTION OF HIGH-STRENGTH CAST IRON MODIFIED WITH RARE EARTH METALS
V. P. Khramov, S. B. Pirkes, M. G. Shestakova, and A. A. Strelkova *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 357-361 refs (See N65-18701 09-17) CFSTI: $7.00

The effect of modifying additives of cerium, REM, and ferrosilicon on the formation of globular graphite in cast iron was investigated. Good formation of globular graphite is dependent on low sulfur content, and is generally difficult to achieve in acid cupola furnaces. In a number of cases, REM additives accomplish sufficient desulfurization if the additive quantity is sufficiently increased. Mechanical tests of heat-treated samples of cast iron modified with REM and ferrosilicon are presented. In some cases, properties exceeding those of cast iron with laminar graphite were achieved. The stoichiometry of large quantities of cerium is not accurately determined by the present standard fluoride separation method. E.P.V.

N65-18796 Lockheed Missiles and Space Co., Palo Alto, Calif. Materials Sciences Lab.
PROPERTIES AND BEHAVIOR OF BERYLLIUM-ALUMINUM ALLOYS
R. W. Fenn, Jr., D. D. Crooks, W. C. Coons, and E. E. Underwood [1964] 44 p refs Presented at the Intern. Conf. on Beryllium Metallurgy and Technol., Philadelphia, 15-17 Oct. 1964 Submitted for Publication
(AD-453918)

A new series of ductile beryllium-aluminum alloys containing 24% to 43% aluminum, which were developed primarily for aerospace use, are evaluated and characterized. Mechanical properties, physical properties, and shop and service characteristics are described for developmental sheet and extrusion alloys as are the mechanical properties of two types of commercially produced Be-38%Al sheet. A structural efficiency comparison between Be-Al and competitive materials is given. Structural efficiency comparisons showed magnesium and aluminum alloys to be about twice as heavy and titanium about three times as heavy as an equivalent load-carrying Be-Al structure. The data also suggest that Be-Al alloys should be capable of achieving 75% of the weight savings possible with beryllium. Author

N65-18886# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
ELECTRICAL RESISTIVITY OF NIOBIUM-ZIRCONIUM ALLOYS BELOW 273.2° K Technical Documentary Report, 1 May 1962-1 May 1964
Donald J. Evans (M.S. Thesis—Ohio State Univ.) Nov. 1964 34 p refs
(ML-TDR-64-234; AD-609798)

An apparatus for measuring the electrical resistivity of materials from 4.2° up to 273.2° K was constructed and used to test niobium zirconium alloys of the following compositions: Nb + 15% Zr, Nb + 25% Zr, Nb + 33% Zr, and Nb + 50% Zr. It was found that the temperature dependence of the electrical resistivity in these alloys is approximately linear, with Matthiessen's rule holding for the lower concentrations. The residual electrical resistivity is shown to depend linearly on zirconium concentration. Author

N65-18911# Springfield Armory, Mass.
HIGH-RATE LOADING: EFFECT ON MECHANICAL PROPERTIES OF Cr-Mo-V AND 4340 STEEL AT AMBIENT TEMPERATURE
Hubert H. Cadle 29 Oct. 1964 30 p ref
(SA-TR18-1203; AD-453994)

Static and dynamic tests were conducted on thick-walled tubes to determine relative values for mechanical properties. The dynamic loading was produced in test specimens as a pressure pulse derived from the propellant gas discharged from a rifle. Results indicate an increase in yield strength of 10% to 20% under dynamic conditions. Procedure is given and results are discussed. Author

N65-19033# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINING PLASTICITY OF HEAT RESISTANT ALLOYS
N. N. Paylov 28 Jan. 1965 14 p refs Transl. into ENGLISH from Tr. Leningr. Politekhn. Inst. (Moscow), no. 222, 1963 p 20-27
(FTD-TT-64-798/1+2; AD-611088)

Plasticity was determined at deposition for one of the heat-resistant alloys. Also included were data on the recrystallization of this alloy, wedge rolling, and torsion experimentation as an aid in the technology of stamping, pressing, and rolling. Dependence of deformation on temperature, on widening characteristics as a function of temperature and compression, and on plasticity during twisting operations is graphically represented. The influence of the critial temperature on deformation is discussed, and the critical temperature for the alloy under investigation was estimated to be 1180° C. E.E.B.

N65-19058# Southern Research Inst., Birmingham, Ala.
MECHANICAL AND PHYSICAL PROPERTIES OF TZM MOLYBDENUM ALLOY SHEET AND OF TUNGSTEN SHEET Quarterly Progress Report, 1 Sep.–1 Dec. 1964
Clifford L. Dotson 22 Jan. 1965 53 p
(Contract N600(19)-59530)
(QPR-8; AD-610564)

Preparation of notched and unnotched tensile specimens of TZM molybdenum has been completed. Recrystallization heat treatment was performed for the TZM molybdenum sheets and a statistical procedure suitable for an analysis of tensile data was established. Room temperature tensile properties are reported for sheets of varying thickness. E.E.B.

N65-19065# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy
DEVELOPMENT OF SUPERIOR STEELS FOR PRECISION GYRO SPIN BEARINGS Technical Documentary Report, 3 Sep. 1963–31 Dec. 1963
D. R. Poirer, R. F. Polich, and M. C. Flemings Wright-Patterson AFB, Ohio, AF Mater. Lab., Dec. 1964 54 p refs
(Contract AF 33(615)-1030)
(ML-TDR-64-276; AD-611538)

Significant microsegregation occurs during the solidification of 52100 alloy. Analysis of homogenization of cast (or wrought) 52100 alloys shows that a residual segregation index is a function of homogenization temperature, homogenization time, and segregate spacing. Techniques are developed for casting thin section, rapidly chilled plates and bearing races of ferrous alloys. Reduced pressure draws molten metal into a copper (or composite copper-refractory) mold. Primary dendrite arm spacings obtained in these castings are extremely fine, ranging from 4 microns at the surface of a 0.10 cm thick cast plate to 46 microns at the center of a 0.64 cm thick plate. A series of inner and outer bearing races were cast using procedures developed and heat treated to a residual segregation index less than 0.10. A series of inner and outer bearing races were also cast of 440C; discussion is included of effects of rapid solidification, and of homogenization, on structure of this material. Author

N65-19071# Pennsylvania State Univ., University Park. Materials Science Lab.
BASIC STUDY OF DISPERSION HARDENING FOR THE ATTAINMENT OF HIGH TEMPERATURE STRENGTH IN MATERIALS Scientific Report, May–Nov. 1964
M. C. Inman, L. E. Murr, and P. J. Smith Dec. 1964 26 p refs
(Grant AF-AFOSR-669-64)
(AFOSR-64-2508; AD-610393)

Electron microscope studies of the substructure of nickel strengthened by dispersed particles of thoria were initiated. The particle size distribution of thoria in the as-received material was determined from electron transmission micrographs of thin films. In addition, a color photography technique was developed for use in studies of dispersed particles. Author

N65-19077# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION ON HIGH STRENGTH ALLOYS AND RIVET LIKE CRYSTALS. REPORTS OF SCIENTIFIC SESSIONS, 1962 Selected Articles
18 Dec. 1964 39 p refs Transl. into ENGLISH from Issled. po Vysokoprochnym Splavam i Nitevidnym Kristallam, Dokl. na Nauchnoy Sessii (USSR), 1963 p 54–60, 98–107, 142–147
(FTD-TT-64-767/1+2; AD-610269)

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3. THERMOMECHANICAL TREATMENT OF TITANIUM ALLOYS A. P. Gulyayev and A. S. Shigarev p 28–36 (See N65-19080 09-17)

N65-19078 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF LOW-TEMPERATURE THERMOMECHANICAL TREATMENT ON THE PROPERTIES OF STEEL
V. D. Sadovskiy, L. V. Smirnov, and G. M. Filonchik *In its* Invest. on High Strength Alloys and Rivet Like Crystals. Repts. of Sci. Sessions, 1962 18 Dec. 1964 p 1–12 refs (See N65-19077 09-17)

The possibility of increasing the hardness, yield strength and yield point of structural and alloy steels through a combination of plastic deformation of austenite with quenching is reported. It was observed that such strengthening does not decrease the impact strength and that elongation remains at the level of 4% to 5%. Also, no change was observed in temper brittleness, in decomposition of the retained austenite, or in the appearance of the carbide phase during tempering. The thermomechanical treatment of steels was found to have a favorable influence on mechanical properties. E.E.B.

N65-19079 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF DEFORMATION OF AUSTENITE ON THE PROPERTIES OF STEEL FOLLOWING QUENCHING
L. I. Kogan, V. I. Sarrak, and R. I. Entin *In its* Invest. on High Strength Alloys and Rivet Like Crystals. Repts. of Sci. Sessions, 1962 18 Dec. 1964 p 13–27 refs (See N65-19077 09-17)

The thermomechanical treatment of steel, consisting of the plastic deformation of metastable austenite followed by a martensite transformation, increases the strength of steel for a given carbon content. The possibility of achieving an ultimate strength of about 300 kg/mm^2 and a yield point of about 160 kg/mm^2, by means of thermomechanical treatment of steel, is considered an accomplished fact. The higher the degree of deformation of supercooled austenite and the lower the deformation temperature, the greater is the effect of the thermomechanical treatment. The effect of plastic deformation on the kinetics of austenite transformations, the influence of thermomechanical treatment on the properties of certain steels, the changes in martensite structure during the treatment, the processes of strengthening of austenite during deformation, and the relationship between the strengthening of austenite during deformation, and the relationship between the strengthening of austenite and the treatment are discussed. E.E.B.

N65-19080 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMOMECHANICAL TREATMENT OF TITANIUM ALLOYS
A. P. Gulyayev and A. S. Shigarev *In its* Invest. on High Strength Alloys and Rivet Like Crystals. Repts. of Sci. Sessions, 1962 18 Dec. 1964 p 28–36 (See N65-19077 09-17)

Increase in strength and plasticity of titanium alloys by thermomechanical treatment is reported. This is explained by a change in phase quantities and a refinement of the grain during deformation. Also, it is reported that the plasticity increases independently of the type of titanium alloy. E.E.B.

N65-19086# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF LIQUID SODIUM ON RELAXATION OF STRESSES IN STEEL
V. I. Nikitin 12 Feb. 1965 11 p refs Transl. into ENGLISH from the publ. "Zhidkiye Metally, Sb. Statey" (USSR), 1963 p 300–306
(FTD-TT-65-123/1+2; AD-611011)

Steel samples were tested in a relaxation chamber, in air and in liquid sodium atmospheres, at 600° C, with initial stresses of 16, 14, and 9 kg/mm^2. Resulting curves show a more rapid reduction of stress in sodium than in air, the difference being greater for higher initial stress. Liquid metal accelerates relaxation at all initial stresses; its influence is most marked during the first stages of relaxation and intensified with increased initial stress. Influences of corrosion, absorption, and diffusion on the effect of the liquid metal medium on solid metal relaxation are discussed. E.P.V.

N65-19089# Martin Co., Denver, Colo.
CRYOGENIC MATERIALS DATA HANDBOOK Progress Report No. 1
F. R. Schwartzberg, S. H. Osgood, R. D. Keys, and T. F. Kiefer Feb. 1965 274 p refs
(Contract AF 33(657)-9161)
(PB-171809(Rev.), Suppl. 1; ML-TDR-64-280, Suppl. 1; AD-611165)

The completely revised handbook presently contains mechanical and physical property data on 62 metallic and nonmetallic materials organized in 8 sections. The handbook also contains material, property, indices and reference list. Progress reports to update and maintain the handbook will be issued semiannually. Author

N65-19121# IIT Research Inst., Chicago, Ill. Technology Center
VANADIUM ALLOY STUDIES Final Report
F. C. Holtz 24 Feb. 1965 32 p refs
(Contract NOw-64-0239-c)
(IITRI-B6021-6; AD-611822)

Coated vanadium alloys containing substantial amounts of refractory metal additions have shown promise for application at 2000° to 2400° F; the principal purpose of this program was to improve the short-time rupture strength. Alloys based on V–60Cb, V–40Cb–30Ta, and V–50Ta were fabricated to 0.025 in. sheet and evaluated for mechanical properties at room temperature and 2200° F. Arc-melted ingots exhibited excellent cold rollability once the cast structure was broken down, and nearly all of the alloys had more than 20% tensile elongation at room temperature. The alloy V–40Cb–30Ta–1Ti–0.235Si–0.075C had an ultimate tensile strength of 210 000 psi in the fully recrystallized condition. Room temperature deformation of most of the alloys was accompanied by extensive twinning. Compositions based on V–50Ta were age hardenable. Creep-rupture data were also obtained. Author

N65-19124# Stanford Univ., Calif. Dept. of Materials Science
THE INFLUENCE OF GRAIN BOUNDARIES AND STACKING FAULTS ON HIGH TEMPERATURE PLASTIC DEFORMATION Third Technical Report
Craig R. Barrett (Ph.D. Thesis) 1 Oct. 1964 213 p refs
(Contract Nonr-225(60))
(SU-DMS-64-22; AD-609250)

The influence of grain size and annealing treatment on the primary and steady-state creep characteristics of high purity copper was studied for grain sizes 0.03 to 0.7 mm in tension at temperatures of 626°, 496°, and 406° C. The relationship between the steady-state creep rate and the grain size was not affected by the annealing temperature. Measurements indicated that the subgrain size generated during creep is independent of grain size, and that the contribution of grain boundary shearing to the total strain increases as the grain size decreases. High temperature creep characteristics of pure silver, copper, nickel, and aluminum with different stacking fault energies showed a steady-state creep rate strongly dependent on the stacking fault energy. The ratio of steady-state creep rate to stacking fault energy of silver and aluminum was approximately a factor of 6000. Etch pit observations on the dislocation substructures of an Fe–3.0%Si alloy of 0.05-, 0.1-, and 0.3-mm grain size showed identical steady-state creep rates. It was concluded that the average dislocation velocity is also a function of strain during primary creep, decreasing with increasing strain. G.G.

N65-19143# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SEAM WELDING OF MAG ALLOY WITH HERMETICALLY SEALED SEAMS
A. A. Chakalev, V. I. Zaytsev, and G. F. Skakun 7 Nov. 1964 12 p refs Transl. into ENGLISH from Svarochnoye Proizvodstvo (Moscow), no. 6, 1964 p 16–19
(FTD-TT-64-1187/1+2; AD-609157)

Magnesium–manganese–cerium alloy properties are discussed. The addition of cerium to the magnesium–manganese system provides low-melting point eutectics. However, the tendency toward forming crystallization cracks is a disadvantage. The problems of welding magnesium alloys are reviewed, and the technology of electrical welding of magnesium is analyzed. It was concluded: (1) During electrical roller welding of magnesium alloys, overheating of the surface leads to crack formation, a reduction in corrosion resistance, and a disruption of seam hermeticity. (2) In order to obtain extended welded joints, the use of double row seams is recommended. Also electrodes with internal water cooling are desirable. E.E.B.

N65-19161# Army Electronics Labs., Fort Monmouth, N. J. Power Sources Div.
A STUDY OF FACTORS AFFECTING THE CORROSION RATE OF MAGNESIUM IN VARIOUS ELECTROLYTES UNDER STATIC CONDITIONS
Carl A. Nordell Aug. 1964 17 p
(ECOM-2517; AD-609588)

The corrosion rates of magnesium and magnesium alloys in magnesium salt solutions of chloride, bromide, and perchlorate were studied by measuring the gaseous reaction product as a function of time. Reliable apparatus was developed to accurately determine the volumes of gas generated. Protective films were applied to the surface of the magnesium metal to suppress excessive chemical reactivity at the metal-electrolyte interface, thereby reducing static corrosion rates. Cromalin, one of the films tested, reduced the gas evolution of an AZ21 Mg-2N $MgBr_2$ system from 400 cc/800 hr to 0.1 cc/800 hr. Author

N65-19198# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PHOTOCALOMETRIC DETERMINATION OF NIOBIUM

Sh. T. Talipov, R. Kh. Dzhiyanbayeva et al 17 Dec. 1964 9 p refs Transl. into ENGLISH from Uzbeksk. Khim. Zh. (USSR), no. 4, 1963 p 18–22
(FTD-TT-64-592/1+2; AD-610216)

The quantitative analysis of niobium in the presence of significant quantities of tungsten, vanadium, nickel, silicon, aluminum, cobalt, chromium, and certain rare earths is discussed. E.E.B.

N65-19225# Brussels Univ. (Belgium).
VAPORIZATION OF COMPOUNDS AND ALLOYS AT HIGH TEMPERATURES. PART XXV: MASS SPECTROMETRIC STUDY OF THE VAPORIZATION OF THE TIN OXIDES. THE DISSOCIATION ENERGY OF SnO
R. Colin, J. Drowart, and G. Verhaegen Wright-Patterson AFB, AF Mater. Lab., Jan 1965 23 p refs
(Contract AF 61(052)-764)
(WADD-TR-60-782, Pt. XXV; AD-611365)

The evaporation of tin oxide SnO_2 and mixtures of tin and tin oxide was studied. The vaporization reactions are

$$SnO_2 \quad \frac{1}{n}(SnO)_n + \frac{1}{2}O_2 \qquad (n = 1,2)$$

$$Sn + SnO_2 \quad \frac{1}{n}(SnO)_n \qquad (n = 1,2,3,4.)$$

The dissociation energy of SnO is D_o° = 126.0 ±1.0 kcal/mole; the polymerization energies are H_{298}° = 66.8 ±4, 136.5 ±5, 207.6 ±5 kcal/mole for $(SnO)_2$, $(SnO)_3$ and $(SnO)_4$, respectively. A reinterpretation of the total vapor pressures was made. Author

N65-19226# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
PROBLEMS IN THE LOAD-CARRYING APPLICATION OF HIGH-STRENGTH STEELS
[1964] 241 p refs Papers presented at a symp. sponsored by the Tripartite Tech. Cooperation Program (TTCP) Sub-Group P on Mater., Working Panel on Metals, Washington, D.C., 26–28 Oct. 1964
(Contract AF 33(615)-1121)
(DMIC-210; AD-611750)

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8. CORROSION PROTECTION OF HIGH-STRENGTH STEELS S. Goldberg (Bur. of Naval Weapons) p 78–90 refs (See N65-19234 09-17)

9. STRESS-CORROSION CRACKING AND CORROSION FATIGUE OF HIGH-STRENGTH STEELS B. F. Brown (NRL) p 91–102 refs (See N65-19235 09-17)

10. PROTECTION AGAINST CORROSION, HYDROGEN EMBRITTLEMENT H. G. Cole (Gt. Brit. Min. of Aviation) p 103–104 (See N65-19236 09-17)

11. THE NOTCH TOUGHNESS OF ULTRAHIGH-STRENGTH STEELS IN RELATION TO DESIGN CONSIDERATIONS R. C. A. Thurston (Canada Dept. of Mines and Tech. Surveys) p 105–124 refs (See N65-19237 09-17)

12. FACTORS AFFECTING THE FRACTURE OF HIGH-STRENGTH STEELS C. L. M. Cottrell (Bristol Aerojet, Ltd.) p 125–135 refs (See N65-19238 09-17)

13. A SURVEY OF THE FATIGUE ASPECTS IN THE APPLICATION OF ULTRAHIGH-STRENGTH STEELS S. R. Swanson p 136–172 refs (See N65-19239 09-17)

14. THE PHYSICAL METALLURGY AND PROPERTIES OF MARAGING STEELS G. E. Pellissier (U.S. Steel Corp.) 173–188 refs (See N65-19240 09-17)

15. THE POTENTIALS OF QUENCHED-AND-TEMPERED HIGH-STRENGTH STEELS S. W. Hollingum (Royal Armament Res. and Develop. Estab.) p 189–200 refs (See N65-19241 09-17)

16. THERMOMECHANICAL TREATMENT OF STEEL J. J. Harwood and R. Clark (Ford Motor Co.) p 201–213 refs (See N65-19242 09-17)

17. ADDITIVE STRENGTHENING MECHANISMS AND THE STRUCTURE OF STEEL J. Nutting (Leeds Univ.) p 214–220 refs (See N65-19243 09-17)

N65-19227 Battelle Memorial Inst., Columbus, Ohio. Ferrous and High Alloy Metallurgy Div.
HIGH-STRENGTH STEEL PERSPECTIVES
A. M. Hall *In its* Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 1–13 refs (See N65-19226 09-17)

The increase in the yield strength of steels used in structural applications during the years since 1850 is reviewed. Nickel–molybdenum, nickel–molybdenum–silicon steels, together with vanadium modifications thereof, and the stainless steels, developed for use at ultrahigh strength levels, are discussed. Also, the advantages and limitations of ultrahigh strength steels, and areas with potentialities for achieving increased performance are summarized. It was concluded that eight or nine families of steels are available today for high-performance structural applications at ultrahigh strength levels. While currently used maximum yield strengths are in the range of 260 000 to 300 000 psi, it has been demonstrated that steels possess considerably greater capabilities. It is not unlikely that these materials will be found in applications at yield strengths well over 400 000 psi in a very few years. E.E.B.

N65-19228 Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
MILITARY APPLICATIONS AND PROPERTY REQUIREMENTS
P. L. Hendricks, H. W. Zoeller, and I. Perlmutter *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 14–23 refs (See N65-19226 09-17)

The importance to the United States Air Force of steels with high strength-to-weight ratios is emphasized. Also, the problems involved in the successful application of present high-strength steels are summarized as (1) the recognition and application of the factors involved in securing a high degree of reliability in performance to insure freedom from system failures, and (2) the development and application of information leading to the production of superior high-strength steels. The applications of high-strength steels of

interest to the Army are reviewed, and the primary problems associated with brittleness of such steels is emphasized. The Navy problem with high-strength steels was summarized as the threat of unpredictable and unexpected failure. The immediate concern was with materials, design deficiencies and deterioration in service which, singly or in combination, cause failure at stresses below design stresses. E.E.B.

N65-19229 Allied Research Associates, Inc., Concord, Mass. ARA Div.
DESIGN PARAMETERS IN MATERIALS SELECTION
George Gerard *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 24–31 refs (See N65-19226 09-17)

Structural applications that could potentially benefit from the use of ultrahigh strength steels are assessed. Also, the design factors retarding the use of such steels for deep-submergence pressure hulls and for pressure vessels applications, such as solid-propellant rocket-engine cases, are examined. One of the major factors retarding the use of ultrahigh strength materials in structural applications is the loss of ductility as the strength level increases. The influence of ductility and stress concentration upon structural strength–weight as compared to material strength–weight is estimated. A guideline for the use of ultrahigh strength steels in tension structures is approximated. E.E.B.

N65-19230 Vanadium-Alloys Steel Co., Latrobe, Pa.
EFFECT OF PRIMARY PROCESSING ON ULTRAHIGH-STRENGTH STEELS
J. C. Hamaker, Jr. *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 32–42 refs (See N65-19226 09-17)

The most important recent primary processing development in making possible the extension of existing steels to higher strength levels, and the introduction of entirely new compositions not otherwise suitable for structures is vacuum melting. The effect of the metallurgical changes produced by vacuum melting on the properties and performance of critically stressed parts is discussed. The surprising effectiveness of special thermal cycles after hot-working in improving properties and performance of ultrahigh strength steel parts is illustrated. The notch toughness of two ultrahigh strength steels compared favorably with conventional titanium and aluminum alloys used for aerospace structures. These materials appeared to decrease in notch toughness as the strength level was raised. It was concluded that primary processing can exert profound effects on ultrahigh strength steels. E.E.B.

N65-19231 Rensselaer Polytechnic Inst., Troy, N. Y.
JOINING OF HIGH-STRENGTH STEELS
Warren F. Savage *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 43–47 (See N65-19226 09-17)

Nominal composition and mechanical properties of quenched and tempered steels, cold-worked stainless steels, precipitation-hardening steels, and maraging steels are tabulated. Also, the welding metallurgy of these four types is discussed. Quenched and tempered steels at high-strength levels can be successfully joined by fusion welding if special care is exercised and the structure can be heat-treated after fabrication. The high-strength, cold-worked stainless steels appear to be unsuited to fabrication by any existing welding technique. The precipitation-hardening stainless steels are marginal in ability to achieve the required yield strength levels. The maraging steels offer the greatest promise as weldable high-strength steels, but additional research is required to establish an adequate technology based upon sound welding metallurgical principles. E.E.B.

N65-19232 Ling-Temco-Vought, Inc., Dallas, Tex. Vought Aeronautics Div.
SECONDARY FORMING PROCESSES AND THEIR EFFECTS ON RESULTING PRODUCTS
William W. Wood *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 48–53 (See N65-19226 09-17)

Manufacturing problems associated with secondary forming of new high-strength steels, and their possible solutions, are presented. The conventional forming processes discussed are bending, flanging, stretching, drawing, and bulging; the advanced processes are shear spinning, high-velocity, high-temperature, and high-pressure forming. The presentation centers around formability, quality of resulting parts, final shaping and sizing, process limitations, and resulting mechanical properties. Formability is discussed for the various processes by giving relative formability of the high-strength steels to other high-strength alloys. The quality of the resulting parts is discussed for distortions such as buckling, twisting and crippling, spring-back, thickness reductions and variations, and inspection techniques. Author

N65-19233 Metcut Research Associates, Inc., Cincinnati, Ohio.
THE SURFACE INTEGRITY OF MACHINED-AND-GROUND HIGH-STRENGTH STEELS
Michael Field and John F. Kahles *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 54–77 refs (See N65-19226 09-17)

In machining or grinding of high-strength steels, there is a strong tendency to produce significant alterations in the surface layer, such as plastic deformation, high-temperature gradients, rehardening, overtempering, and residual stress. Data are presented which show the advantages of using low-stress machining-and-grinding conditions to control these surface alterations and their resultant effects on distortion, stress corrosion, and mechanical properties, including fatigue, of high-strength steels. In using uncontrolled machining or grinding conditions, a rehardened brittle martensitic layer is developed on the surface during drilling, milling, grinding, and abrasive cutoff. Similar rehardened layers along with remelted surface material are observed in electrical-discharge machining. Secondary methods to impart beneficial surface characteristics to machined and ground surfaces, such as heat treating, shot peening, and tumbling, are reviewed along with methods for detection and measurement of surface changes. Author

N65-19234 Bureau of Naval Weapons, Washington, D. C.
CORROSION PROTECTION OF HIGH-STRENGTH STEELS
S. Goldberg *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 78–90 refs (See N65-19226 09-17)

Stress-corrosion cracking, hydrogen embrittlement, and corrosion fatigue are considerations in serviceable corrosion protective systems. The environmental conditions are −65° F to approximately 1000° F in marine environments of the spray type with intermittent bold exposure. Although 12% type chromium steels have been widely used without protective coatings, these materials require protection for many applications. Higher chromium-content materials, although not requiring corrosion protection when used alone, require coatings where they may

contact other materials or are mechanically joined with themselves. Although successful protective schemes are being used, substantive advances are needed to simplify application and maintenance. Also required are nondestructive test methods to evaluate corrosion damage which may occur. Author

N65-19235 Naval Research Lab., Washington, D. C.
STRESS-CORROSION CRACKING AND CORROSION FATIGUE OF HIGH-STRENGTH STEELS
B. F. Brown *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 91–102 refs (See N65-19226 09-17)

Indications from present test methods are that many heat-treated steels are susceptible to stress-corrosion cracking at strength levels as low as 150–175 ksi yield strength in reasonable environments, and that the susceptibility increases with increasing yield strength. In approximately the same strength range, these steels also begin to exhibit susceptibility to hydrogen embrittlement, so that cathodic protection against stress-corrosion cracking cannot be used in seawater, and inorganic zinc coatings are unsuitable. A new requirement is thus imposed upon coatings for at least some of these steels; i.e., the coatings must be more than corrosion barriers, they must be vapor barriers as well. Author

N65-19236 Gt. Brit. Ministry of Aviation, London.
PROTECTION AGAINST CORROSION, HYDROGEN EMBRITTLEMENT
H. G. Cole *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 103–104 (See N65-19226 09-17)

The problem of hydrogen embrittlement, theories for the movement of hydrogen through steel, and the way in which it reduces the cohesive strength of the steel are discussed. The value of cleanness and of low sulfur and phosphorus content, not only for improved mechanical properties, but also for raising the threshold hydrogen content below which embrittlement does not occur is emphasized. Cleaning processes, protective coatings, and stress corrosion are included. Cadmium plating plus paint is considered the best protective for steel, although some hold the view that phosphate treatment plus paint is as good or even better. E.E.B.

N65-19237 Canada. Dept. of Mines and Tech. Surveys, Ottawa. Physical Metallurgy Div.
THE NOTCH TOUGHNESS OF ULTRAHIGH-STRENGTH STEELS IN RELATION TO DESIGN CONSIDERATIONS
R. C. A. Thurston *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 105–124 refs (See N65-19226 09-17)

Chemical composition and notch-toughness data are tabulated for selected low-alloy structural, hot-die and tool, nickel alloy, and precipitation-hardening ultrahigh strength steels. The 18% nickel maraging steel was found to possess a definite superiority over earlier steels and should be of particular interest to the designer of high-strength minimum-weight hardware. The more recently developed 9Ni–4Co alloy also appears to have desirable characteristics. The effect of the processing variables, melting practice, composition, and thermomechanical treatment; of environment, and of loading rate on the toughness of ultrahigh strength steels is summarized. Tests on typical hardware and design requirements are included. E.E.B.

N65-19238 Bristol Aerojet, Ltd., Banwell (England).
FACTORS AFFECTING THE FRACTURE OF HIGH-STRENGTH STEELS
C. L. M. Cottrell *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 125–135 refs (See N65-19226 09-17)

Factors affecting the fracture of thin-walled high-strength steel rocket motor cases of welded construction were studied. Those factors which affect crack initiation and slow propagation are of prime importance. The effect of steel composition on the liability of high-strength steels to weld hot-cracking was demonstrated for low-alloy high-strength steels. Crack initiation in the parent material is shown to be markedly affected by steel purity, in addition to the general alloy content of the steel. In the case of 18% nickel–cobalt–molybdenum maraging steel, reducing the test temperature to −94° F has no effect on crack initiation susceptibility. Testing steels after immersion in water and in the air produces a slight increase in crack initiation susceptibility. E.E.B.

N65-19239 De Havilland Aircraft Co., Ltd., Downsview (Ontario).
A SURVEY OF THE FATIGUE ASPECTS IN THE APPLICATION OF ULTRAHIGH-STRENGTH STEELS
S. R. Swanson *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 136–172 refs (See N65-19226 09-17)

A new criterion is put forward, namely, the fatigue strength (in terms of root mean square stress) for 1 million cycles of a Rayleigh distribution of stress amplitudes. Such a test is statistically unique, quite simply obtained by exciting a single-degree-of-freedom system containing the specimen with random noise, and can often be applied directly to service problems without resorting to tenuous cumulative damage theories. An example of the application of this criterion (from a small number of Rayleigh tests) to assess the fatigue life of the DHC Hydrofoil main foil (to be made from 250 ksi Y. S. maraging steel) is presented. A brief comparison of the fatigue strength of maraging steels manufactured by different methods is given for various test conditions (e.g., air, salt water corrosion, butt welded, etc.) to indicate what compromises in the selection of manufacturing processes can be made if the ultimate application is kept in mind. Some findings on notched specimen fatigue are given. A short discussion of scale effect in the fatigue of maraging steels is included. Author

N65-19240 United States Steel Corp., Monroeville, Pa. Applied Research Lab.
THE PHYSICAL METALLURGY AND PROPERTIES OF MARAGING STEELS
G. E. Pellissier *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 173–188 refs (See N65-19226 09-17)
(Contract AF 33(657)-11149)

Mechanical properties, transformation characteristics, aging, strengthening mechanisms and roles of the alloying elements, interdendritic segregation, banding, and retained austenite, directionality of tensile properties, thermal embrittlement, thermal stress and weld cracking, and the effects of minor and residual elements on notch toughness of 18 Ni (250) and (280) maraging steel are examined in detail. It was concluded that maraging steels represent a major and important advance toward the goal of achieving ultrahigh strength steels for use in high integrity construction. E.E.B.

N65-19241 Royal Armament Research and Development Establishment, Fort Halstead (England).
THE POTENTIALS OF QUENCHED-AND-TEMPERED HIGH-STRENGTH STEELS

S. W. Hollingum *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 189–200 refs (See N65-19226 09-17)

Composition and properties of some very high-strength quenched and tempered steels are tabulated. The development of these steels, the effects of heat treatment, machining and potential applications, and trends are presented. It was concluded that many quenched and tempered very high-strength steels are available which possess good ductility, adequate fracture toughness, good fatigue properties, and satisfactory low temperature properties. To satisfy stringent requirements for transverse ductility, toughness, and reliable fatigue properties, it is important to achieve a high purity and a high degree of cleanness, with the result that improved steel-making and refining techniques, and vacuum melting, are used extensively. E.E.B.

N65-19242 Ford Motor Co., Dearborn, Mich. Scientific Lab.
THERMOMECHANICAL TREATMENT OF STEEL
J. J. Harwood and R. Clark *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 201–213 refs (See N65-19226 09-17)

Thermomechanical treatment (TMT) characterized by the plastic deformation of austenite followed immediately by quenching to martensite and subsequent tempering is discussed. Macroscopic behavior of metastable austenite, microstructure of deformed metastable austenite, behavior of martensite, and process variables are reviewed. Application studies of ausformed steels are summarized. Thermomechanical treatment of alloy steels, involving the deformation of austenite prior to quenching to martensite, is a highly effective means for achieving ultrahigh hardness, fatigue strength, fracture toughness, and wear resistance. The best properties are obtained in alloys containing balanced compositions of carbon content and alloy carbide forming elements such as Mo, Cr, and V. E.E.B.

N65-19243 Leeds Univ. (England). Houldsworth School of Applied Science
ADDITIVE STRENGTHENING MECHANISMS AND THE STRUCTURE OF STEEL
J. Nutting *In* Battelle Mem. Inst. Probl. in the Load-Carrying Appl. of High-Strength Steels [1964] p 214–220 refs (See N65-19226 09-17)

The interaction of two, three, and four hardening mechanisms and examples of additive hardening in steel are discussed. Work hardening, grain boundary hardening, dispersion hardening, solid-solution hardening, and precipitation hardening are the methods explored. The high strength of ausformed steels is shown to be a consequence of the additive effects of four hardening mechanisms: a fine grain size from the martensite; a dispersion of alloy carbides produced during ausforming and tempering, the distribution of which is controlled by the dislocation distribution; a high dislocation density generated by working and by the shear transformation; and a small component from the solute elements in substitutional solid solution. E.E.B.

N65-19255# Naval Research Lab., Washington, D. C. Chemistry Div.
CORROSION OF METALS IN TROPICAL ENVIRONMENTS. PART G: ALUMINUM AND MAGNESIUM
C. R. Southwell, C. W. Hummer, Jr., and A. L. Alexander 1 Dec. 1964 18 p refs
(NRL-6105; AD-609618) CFSTI: $0.50

The corrosion resistance of 3 alloys of aluminum and 2 alloys of magnesium was studied following exposure up to 16 years in 5 natural tropical environments. These include sea water immersion, fresh water immersion, and exposure to tidal sea water, a tropical marine atmosphere, and a tropical inland atmosphere. Aluminum 1100, aluminum alloy 6061-T, and magnesium alloy AZ31X were exposed to each environment. In addition, Alclad aluminum 2024-T and magnesium alloy AZ61X were exposed to the two tropical atmospheres. Weight loss, pitting, and change in tensile properties were measured to show the extent of corrosion for each of these materials. Aluminum alloys demonstrate extremely high resistance to each environment, with the exception of tropical fresh water, in which case serious pitting occurred. Alloy 6061-T demonstrated some superiority in all environments to aluminum 1100. Author

N65-19314# Watervliet Arsenal, N. Y. Benét R & E Labs.
A STUDY OF THE EFFECT OF SOLIDIFICATION IMPERFECTIONS ON THE TENSILE PROPERTIES OF CAST STEEL
Bruce L. Bramfitt and Leonard Livzzi Sep. 1964 28 p refs
(WVT-6420; AD-609451)

The need for a correlation between mechanical properties and imperfection size as determined by radiographic standards has greatly increased. This investigation was initiated to establish such a correlation with cast 4140 steel heat-treated to a strength level of 180000 to 200000 psi. Solidification imperfections of both the gas type and the shrinkage type were studied. A least squares statistical regression analysis has shown that tensile strength decreases linearly as imperfection size increases. No significant difference between the two types of imperfections in reducing the tensile strength was noted. From the results of this investigation a practical method can be devised for establishing radiographic standards for castings. Author

N65-19336# California Univ., Livermore. Lawrence Radiation Lab.
MARAGING STEEL, A BIBLIOGRAPHY
Penelope Bloom Dec. 1964 52 p refs
(Contract W-7405-ENG-48)
(UCRL-12223) CFSTI: $3.00

N65-19359# Pennsylvania State Univ., University Park. Dept. of Physics
FIELD ION MICROSCOPY OF IRON WHISKERS Final Report
Erwin M. Müller and Osamu Nishikawa Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 26 p refs
(Contract AF 33(657)-11242)
(AFML-TR-64-346; AD-609859)

Further investigation of the imaging properties of neon in the field ion microscope revealed that the large difference between the neon and helium images of iron whiskers is due to the efficient energy transfer in the collision of neon atoms having polarization energy with the surface metal atoms. Whiskers grown under various conditions were observed by the field ion microscope. It was found that the whiskers grown in the ultrapure system had a low density of lattice defects and impurities. Some whiskers were observed with the help of an image intensifier. Author

N65-19371# Wah Chang Corp., Albany, Oreg. Albany Div.
FABRICATION OF WIDE TUNGSTEN SHEET BY POINT DEFORMATION TECHNIQUES Final Report, Jul. 1, 1961–Dec. 31, 1964

Samuel A. Worcester 31 Dec. 1964 180 p refs
(Contract NOw-61-1046-c)
(AD-61162)

Cylindrical flow-turn blanks were manufactured by (1) forming and welding of plate, (2) ring rolling of sintered ring preforms, and (3) upset forging, back extruding, and ring rolling of sintered tungsten billets. Although cylindrical blanks made by all three techniques were flow turned with some success, blanks made by upset forging, back extruding, and ring rolling provided the greatest flexibility in selection of flow-turning parameters. Tungsten cylinders prepared by upset forging, back extruding, and ring rolling were successfully flow turned at temperatures between 1200° and 1600° F with pass reductions of 10% to 65% and to thicknesses as low as 0.030 in. without intermediate anneals. Examination of sheet produced by slitting and flattening the flow-turned tubes revealed that grain refinement occurs during the flow-turning operation, apparently as a result of simultaneous recrystallization which occurred during the flow-turning operation at all temperatures from 1000° to 1600° F. Bend transition temperatures for flow-turned sheet varied from 200° F to greater than 900° F depending on the average reduction per pass, flow-turning temperature, and direction of test. Axial transition temperatures were consistently lower than circumferential transition temperatures, and the transition temperature of sheet tested with the outside surface of the original flow-turned tube in tension was consistently higher than that of sheet tested with the inside surface of the tube in tension. Bend transition temperature generally increased with increased reduction per pass and increased flow-turning temperature. Gage control was difficult because of variable machine deflection with changing flow-turning parameters. Author

N65-19373# Manlabs, Inc., Cambridge, Mass.
THERMOMECHANICAL TREATMENTS APPLIED TO ULTRA-HIGH STRENGTH STEELS Progress Report
D. Kalish and S. A. Kulin Dec. 1964 29 p refs
(Contract NOw-64-0356-c)
(PR-3; AD-611025)

The mechanical properties of 45% C–9% Ni–4% Co alloy (steel H) are reported as a function of pretempering temperature for strain tempering of martensite. Data on the influence of retempering temperature on strain-tempered martensite are also included. A comparison is made of precracked Charpy impact energy as a function of yield strength for steel H bainite and martensite. Austenite deformation prior to transformation to martensite in steel H may significantly improve the strength of steel H with a small loss in toughness. The effect of the amount of deformation in strain-tempering on the mechanical properties of martensite was determined. A study of the effects of deformation on the structure of quenched or tempered martensite may help provide an understanding of the changes in mechanical properties noted in strain tempering. E.E.B.

N65-19375# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
PREMIUM-QUALITY ALUMINUM CASTINGS
K. R. Grube, D. N. Williams, and H. R. Ogden 4 Jan. 1965 44 p refs
(Contract AF 33(615)-1121)
(DMIC-211; AD-611021)

Premium-quality aluminum castings are guaranteed to show a specified high level of mechanical properties. Advances have resulted largely from the application of improved casting techniques which include (1) the use of high-purity ingot (low iron content); (2) adequate degassing and proper melting procedures; (3) streamlined gating design to avoid turbulence and aspiration of mold gases; (4) the use of a sufficient number of risers to feed the casting adequately; (5) the liberal use of chills to control the solidification rate and provide directional solidification; and (6) the use of high-temperature solution heat treatment followed by artificial aging to develop maximum mechanical properties. At present, the A356, C355, and several modifications of these alloys represent the alloys being most widely used in premium-quality castings. The chief application for these has been in the aerospace industry where their combination of low weight and high reliability has led to a growing acceptance and interest in these materials. Author

N65-19433# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
SOME DIRECT OBSERVATIONS OF CUMULATIVE FATIGUE DAMAGE IN METALS
W. A. Wood and W. H. Reimann Oct. 1964 27 p refs
(Contract Nonr-266(91))
(TR-11; AD-610562)

Metallographic techniques used previously to study how fatigue damage develops in fatigue specimens subjected to cyclic strain at constant amplitude are extended to the study of damage produced when cyclic strain is introduced in one range of amplitudes and continued in another. Reactions particularly studied were those between the H or large-amplitude range and the F or small-amplitude range as found in Fcc metal. It is shown how the type of damage produced by combination of H and F amplitude differs from that produced by either amplitude alone and depends upon the order of application. Damage is especially drastic if H cycles follow a sequence of F cycles which have established slip-zone fissures; suggestions are made on how this particular consequence may be avoided. Author

N65-19436# IIT Research Inst., Chicago, Ill. Technology Center
INTERFACE FRICTION IN HOT METAL DEFORMATION Fourth Bimonthly Report, Nov. 24, 1964–Jan. 23, 1965
J. A. Schey [1965] 9 p ref
(Contract NOw-64-0458-f)
(IITRI-B6027-4; AD-611821)

Work on the compression and friction phenomena of the tool–workpiece interface during hot deformation processing of metals was performed with emphasis on 7075 Al and 6Al-4V-Ti with WC (10% Co) anvils. Typical standard compression curves had to be established since the working surface of the anvils was changed by machining. The experimental data were utilized to determine the friction coefficient for 7075 Al at 450° C with the WC anvils at 300° and the data for the points are presented. Typical compression curves for the Ti alloy at 1000° C with WC anvils at 300° C show an unexpected maximum and minimum in the lubricated curve in contrast to the unlubricated anvil curves. G.G.

N65-19463# IIT Research Inst., Chicago, Ill. Technology Center
STRESS-DEPENDENT INTERACTIONS BETWEEN CESIUM AND OTHER MATERIALS Interim Technical Report, Feb. 15–Oct. 31, 1963
5 Dec. 1963 50 p refs
(Contract Nonr-344(00))
(IITRI-B215-16; AD-425583)

Times up to 1000 hours, and stresses in excess of the individual yield stresses were employed in these studies under molten cesium. A continuous cesium film was maintained

No instance of static fatigue was observed. Because all prior experience indicates the static fatigue problem to be severe at low temperatures, static fatigue is now not felt to be a problem in the thermionic diode materials as a result of the presence of cesium. The actual service temperatures would in all cases be above the transition temperatures if the systems behaved in typical fashion. There has been no evidence, to date, that they do not. In materials in which molten cesium is effective in reducing mechanical ductility the cesium metal in the vapor phase is similarly effective. Molten cesium was found to improve the ductility of Kovar and tungsten. The behavior of alumina ceramics was found dependent upon constitution. Crystalline Al_2O_3, free of glassy material in grain boundaries, is weakened appreciably by the presence of molten cesium. Lower alumina ceramics, containing a grain boundary glassy phase, were not affected. Other aspects of the importance of constitution were observed. Cold-worked stainless steels (302 type) were not affected whereas the same material in the annealed condition was measurably changed by cesium contact. Author

N65-19457# IIT Research Inst., Chicago, Ill. Technology Center

STRESS DEPENDENT INTERACTIONS BETWEEN CESIUM AND OTHER MATERIALS Summary Report, Feb. 16, 1962–Feb. 15, 1963

David W. Levinson 22 Mar. 1963 55 p refs

(Contract Nonr-3441(00))

(ARF-B215-12; AD-401666)

Metals and alloys germane to thermionic energy converter usage were screened for embrittlement by liquid cesium metal. The results of the screening evaluations are reported and techniques are described for more detailed studies of ceramics and susceptible metals. Definite reductions in tensile ductility were observed for 302 stainless steel and molybdenum. Bend ductility was lowered in the cases of unalloyed titanium, titanium–aluminum–vanadium alloy, columbium, tantalum, and silver–copper eutectic solder. Some difficulty in reproducibly wetting samples was evident throughout the study. Slightly contaminating the cesium with oxygen (or water) was observed to increase cesium wettability markedly. Author

N65-19464# Battelle Memorial Inst., Columbus, Ohio.

DEVELOPMENT OF NIOBIUM ALLOYS RESISTANT TO SUPERHEATED STEAM

Arthur A. Bauer, Warren E. Berry, John A. De Mastry, Robert D. Koester, and Frank A. Rough 11 Nov. 1964 47 p refs

(Contract W-7405-ENG-92)

(BMI-1700, EURAEC-1285) CFSTI: $1.00

Niobium-base alloys containing additions of 18 to 24 a/o titanium, 12 to 18 a/o vanadium, and 9 to 12 a/o chromium were prepared by arc melting, and evaluated for corrosion resistance in the cold-worked condition. Alloys containing greater than 9 a/o chromium could not be cold rolled because of a $NbCr_2$ precipitate in the grain boundaries. The niobium-21 a/o titanium-12 a/o vanadium-9 a/o chromium alloy was found to have excellent corrosion resistance to attack by 540° C deoxygenated steam, having a total weight gain of 465 mg per dm^2 for 10 000 hr of exposure. The resistance to steam attack at 650° and 705° C appears to be adequate to withstand reactor temperature transients. There was no evidence of stress corrosion in 540° C steam or in steam to which chloride ions had been added. Loop tests indicated that the niobium-21 a/o titanium-12 a/o vanadium-9 a/o chromium alloy does not have satisfactory corrosion resistance to BWR superheater steam (20-ppm oxygen and 2.5-ppm hydrogen) at 566° C. The 540° C short-time tensile properties were excellent, the alloy processing a yield strength of 150 000 psi and an ultimate tensile strength of 170 000 psi. Recrystallization occurs in 1 hr at 1150° ±10° C. Author

N65-19465# Illinois Univ., Urbana. Coll. of Engineering

THE EFFECTS OF 60-CYCLE ALTERNATING CURRENTS ON THE CORROSION OF STEELS AND OTHER METALS BURIED IN SOILS Engineering Experiment Station Bulletin 470

Walter H. Bruckner Nov. 1964 64 p refs Available from Illinois Univ.: $1.50

In laboratory-operated cells which simulated field conditions of metal buried in soil, ac was found effective in accelerating the soil corrosion of all metals tested, including ferrous and nonferrous alloys. Corrosion due to ac resulted from thermal and electrical effects. The electrical effects may be contributed by ac only when dc is blocked from the circuit. No consistent relationship could be found between ac and the dc component in cells with steel electrodes. In addition, a dc component was found in cells with apparently identical steel electrodes and environment. The presence of ac in an electrical circuit composed of different metals buried in soil increased the dc current in the galvanic cell, and increased the corrosion rate normally expected for the anode of such a cell. Author

N65-19499# Solar, San Diego, Calif. Research Labs.

DEVELOPMENT OF PROTECTIVE COATINGS FOR TANTALUM BASE ALLOYS. TASK II: DEVELOPMENT OF TECHNOLOGY APPLICABLE TO COATINGS USED IN THE 3000 TO 4000 F TEMPERATURE RANGE Interim Summary Report, 1 Jun. 1963–31 May 1964

B. Ohnysty, O. M. Stansfield, A. R. Stetson, and A. G. Metcalfe Wright-Patterson AFB, Ohio. Res. and Technol. Div., 29 Jan. 1965 98 p refs

(Contract AF 33(657)-11259)

(RDR-1360-10; ML-TDR-64-294; AD-612061)

Studies of bulk oxides were made to determine what modifier oxides would be required to form the optimum oxide coating. Thermal expansion measurements were performed on oxides from 1500° to 4000° F to determine the expansion match with tantalum. Electrical conductivity of an oxide was used as one indication of the diffusion characteristics of an oxide; hence its protective ability. Compatibility tests were also conducted with oxide, reservoir, barrier, and substrate material. The experimental results indicate that hafnia or hafnia modified with ZrO_2 and Y_2O_3 are suitable for continued investigation as coating materials. Hafnium appears to be a suitable reservoir material with tungsten as a barrier on tantalum. Author

N65-19534# Bureau of Mines, Pittsburgh, Pa.

THE RECOVERY OF MANGANESE FROM OPEN-HEARTH SLAGS AND LOW-GRADE ORES BY SMELTING AND SELECTIVE OXIDATION

R. C. Buehl, Miles B. Royer, and J. P. Morris 1965 38 p refs

(BM-RI-6596)

This process for recovering manganese from open-hearth furnace slags or low-grade manganiferous iron ores is described. The slag or ore is smelted in a blast furnace to produce spiegeleisen, which is then blown with air in a basic converter to give an oxide slag. This slag contains 60% to 75% manganous oxide and may be considered a synthetic manganese ore. In the smelting coke rates for five test periods ranged from 3255 to 4130 lb per ton of spiegeleisen. Recovery of manganese in the spiegeleisen varied from 60% to 78%, and increased

to 83% when the open-hearth slag feed to the blast furnace was diluted with a high-grade iron ore sinter. In blowing the spiegeleisen a cyclic procedure was developed that gave nearly 90% recovery of manganese in the slag product yet prevented excessive contamination of the slag by phosphorus and iron. The overall recovery of manganese was about 75% when iron ore sinter was used with the open-hearth slag in the smelting step. The metal remaining after oxidizing the manganese from the spiegeleisen contained approximately 3.5% phosphorus, and was refined in a basic converter by blowing with air in the presence of lime. A high-grade iron and a basic phosphate slag were produced. Author

N65-19539# Joint Publications Research Service, Washington, D. C.
APPLICATION OF INDUCTION HEATING IN MICROMETALLURGY
G. F. Golovin, ed. 22 Mar. 1965 50 p refs Transl. into ENGLISH of chapter 6 from "Promyshlennoye Primeneniye Tokov Vysokoy Chastoty" Leningrad, 1964 p 249–290
(JPRS-29213; TT-65-30553) CFSTI: $2.00

A new method of crucible-less electromagnetic levitation melting of metals is discussed. The method makes it possible to (1) obtain castings from chemically active materials with a purity equal to the original charge; (2) obtain a uniform multicomponent alloy in a common liquid bath of well-mixed metal; (3) heat the metal high enough to ensure a good solution even in the case of such refractory additives as tungsten; (4) melt in a low vacuum or helium atmosphere; (5) obtain alloys without nonequilibrium crystallization; (6) investigate the interaction of metals with gases; (7) melt several dozen samples of the same or various compositions without opening the chamber. E.E.B.

N65-19546# Argonne National Lab., Ill. Metallurgy Div.
SELECTION OF THE STRUCTURAL MATERIAL FOR THE FARET LIQUID-METAL SYSTEMS
L. R. Kelman and R. J. Dunworth Dec. 1964 27 p refs
(Contract W-31-109-ENG-38)
(ANL-6939) CFSTI: $2.00

The Faret conditions of 650° C sodium in an intense neutron environment are an extrapolation from current knowledge, necessitating some element of risk and speculation in the selection of a material. It was found that AISI 304 stainless steel comes closest to meeting Faret conditions and material selection requirements. Type 316 stainless steel was the second choice. It was considered less desirable because of its tendency to develop sigma phase on long-time exposure at Faret temperatures. Also, neutron irradiation may accelerate sigma formation, especially if the material is under stress. Types 347 and 321 stainless steel and high chromium austenitic stainless steels were eliminated because of welding problems, and because they are subject to embrittlement from sigma formation. The super alloys were also eliminated. E.E.B.

N65-19549# General Electric Co., Evendale, Ohio. Flight Propulsion Lab. Dept.
REFRACTORY MATERIALS RESEARCH, PART IV Final Annual Report, 1 Jul. 1962–30 Oct. 1963
G. M. Kibler, T. F. Lyon, M. J. Linevsky, and V. J. De Santis Wright-Patterson AFB, Ohio. AF Mater. Lab., Aug. 1964 152 p refs
(Contract AF 33(616)-6841)
(WADD-TR-60-646, Pt. IV; AD-606836)

Vapor pressure studies of hafnium and tantalum nitride were completed using Knudsen effusion method combined with a gas collection and measuring system. The vaporization of ZrB_2 has been studied, also by a Knudsen effusion method, modified in this application to obtain the effusion rate by continuous weighing of condensed effusate. Matrix isolation studies of the vapor from ZrO_2 and HfO_2 were made as were measurements with ThO_2. Resonance line absorption photometry was applied to ZrB_2. The results obtained are presented and discussed. Normal spectral emissivity data on single crystal tungsten, pyrolytic graphite, and tantalum nitride are reported. Author

N65-19552# North American Aviation, Inc., Los Angeles, Calif.
ELECTRON MICROSCOPY OF SOLID STATE BONDS
George Martin and C. G. Thomas 9 Oct. 1964 17 p Presented at the Ann. Symp. of the Electron Microscopy Soc. of Am., Detroit, 14 Oct. 1964
(NA-64-1040)

The paper presents the results of various methods of specimen preparation for the electron microscopic investigation by replica methods of solid-state bonds. It was found that in order to bring out grain size details, a heavy etch is required, which is apt to obscure interface deformation details. Cathodic etching of specimens by a glow discharge appears to be a very promising method of bringing out interface details. In addition, a great deal of information on bonding mechanisms and bond failure modes can be learned from fractographs of bonded specimens broken by impact testing equipment. Author

N65-19557# IIT Research Inst., Chicago, Ill. Technology Center
HIGH-TEMPERATURE OXIDATION-PROTECTIVE COATINGS FOR VANADIUM-BASE ALLOYS Final Report, Oct. 1, 1963–Sep. 30, 1964
1 Dec. 1964 42 p
(Contract NOw-64-0140-c)
(IITRI-B6019-6; AD-611376)

The objective of this program was the development of oxidation-protective coatings for vanadium-base alloys for use at 1800° to 2500° F. Specifically, the effect of the pack-siliconizing process and the silicide coating itself on the mechanical properties of 0.020 in. thick sheet of V-60Cb-1Ti (wt. %) was studied. Both parameters have little effect on strength, but cause some reduction in tensile ductility. However, the tensile transition temperature remains less than −320° F after coating. Also, there is little or no embrittlement of this coated sheet after 25 4-hr oxidation cycles at temperatures up to 2300° F in static laboratory air. At reduced pressures, useful life is at least 10 2-hr cycles at the above temperatures. The static oxidation life of other vanadium-base alloys, coated by the pack-siliconizing process, has also been investigated. V-40Cb-30Ta-1Ti, the most promising of these alloys, has an oxidation life of about 50 hr at 2200° F, and less under cyclic conditions. Author

N65-19569# IIT Research Inst., Chicago, Ill. Metallurgical Engineering Dept.
SHORT-RANGE FORCES IN ALLOYS Summary Report
Leonid V. Azaroff 15 Jul. 1964 8 p ref
(Contract Nonr-1406(07))
(AD-602521)

The power of the X-ray absorption spectra to elucidate short-range forces operating in alloys having been clearly demonstrated, it remains to apply this method to various alloy systems. A study of transition metals and alloys is urgent; thus, several alloy systems containing the magnetic elements Fe, Co, and Ni will be examined. Alloys containing copper

deserve study also because of their practical importance and because complementary data are readily available to help characterize them. Author

N65-19575# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF ALLOYING ON THE HARDNESS OF NiAl AND ITS SOLID SOLUTIONS

L. A. Kucherenko, V. A. Troshkina, and K. B. Khomyakov 22 Dec. 1964 7 p refs Transl. into ENGLISH from Moscow Univ. Vestn. Ser. II Khim. (USSR), no. 1, 1964 p 53–55
(FTD-TT-64-1270/1+2; AD-609783)

The role of small amounts (1% and 3%) of the additives Mn, Fe, Co, and Cu on the hardness of NiAl of stoichiometric compositions (68.5%Ni–31.5%Al, 67.5%Ni–31.5%Al, 65.5%Ni–31.5%Al, 68.5%Ni–30.5%Al, and 68.5%Ni–28.5%Al) was investigated. Hardness was measured on a durometer with a load of 5 kg and 30-second duration on annealed specimens after tempering from 500° to 800° C in a cooled 5% alkali solution. Results are given for specimens measured in kg/mm^2. E.E.B.

N65-19587# General Technologies Corp., Alexandria, Va.

A STUDY OF HIGH MODULUS, HIGH STRENGTH FILAMENT MATERIALS BY DEPOSITION TECHNIQUES Final Report, 1 Nov. 1963–31 Oct. 1964

L. G. Davies, J. C. Withers, and D. F. Bazzarre 1 Jan. 1965 39 p refs
(Contract NOw-64-0176-c)
(AD-611757)

The primary objective of the investigation was to establish feasibility for depositing the desired materials by state-of-the-art vapor deposition techniques upon a substrate in filament form. The materials selected for study on the basis of their high modulus-to-density ratio were boron carbide, silicon carbide, boron, titanium boride, titanium carbide, beryllium, beryllium oxide, and aluminum oxide. The boron carbide, silicon carbide, and boron deposition reactions produced high-quality coatings at reasonable deposition rates. The other materials produced filaments of generally lower strengths, probably due, in part, to the high crystallinity of the coating. Beryllium, beryllium oxide, and aluminum oxide had very low deposition rates. The tensile-strength of the boron carbide filaments ranged from 48×10^3 psi to 113×10^3 psi on 0.001-in. tungsten substrates. The silicon carbide had tensile strength to 200×10^3 psi, and boron had strengths to 190×10^3 psi. Silicon carbide had the highest modulus of elasticity of the materials studied, while titanium carbide had the lowest. It was found that the structure and, therefore, the strength was quite sensitive to the deposition parameters. Author

N65-19591# Joint Publications Research Service, Washington, D. C.

STRUCTURE AND PROPERTIES OF TITANIUM ALLOY WELD JOINTS

V. F. Grabin and Ye. O. Paton 15 Mar. 1965 93 p refs Transl. into ENGLISH of the Book "Struktura i Svoystva Svarnykh Soyedineniy iz Titanovykh Splavov" Kiev, Naukova Dumka, 1964 p 3–106
(JPRS-29119; TT-65-30512) CFSTI: $4.00

Characteristics of titanium alloys and the technology of the welding of titanium are presented. Specific attention is given to the structure and properties before and after heat treatment of the welded joint and the area of the heat affected zone, for several Soviet titanium alloys. E.E.B.

N65-19592# Joint Publications Research Service, Washington, D. C.

STEELS IN POWER MACHINERY Selected Articles

16 Mar. 1965 26 p refs Transl. into ENGLISH from Energomashinostr. (Moscow), no. 10, Oct. 1964 p 26–29, 29–30, 30–32
(JPRS-29139; TT-65-30520) CFSTI: $1.00

The first article discusses the apparent discrepancy between laboratory data on the stability of stainless and carbon steels and their actual resistance to cavitational erosion under operating conditions in hydroelectric turbines. Mechanical and impact-corrosional aspects of steel disintegration are considered in demonstrating that differences in cavitation intensity account for variations in the stability data. The second article discusses the effects of annealing variables on the strength and durability of steel pins with rolled threads. The third article discusses the ways in which an oxide layer influences the kinetic and diffusion reactions of gas corrosion of steel, particularly in cases where the oxide layer is continually being chipped away. M.P.G.

N65-19598# Cornell Univ., Ithaca, N. Y. Dept. of Engineering Physics and Materials Science

NUCLEATION OF METAL CRYSTALS ON IONIC SURFACES

J. L. Robins and T. N. Rhodin 1 Oct. 1964 21 p refs
(Contract Nonr-401(31))
(TR-8; AD-608915)

A systematic experimental study of the kinetics of nucleation of gold vapor onto the (100) cleavage face of magnesium oxide was made over the temperature range from 209°–381° C in ultrahigh vacuum. The degree to which preferred nucleation occurred was found to depend on the defect structure of the surface. The experimental results are in quantitative agreement with a nucleation model originally developed for a defect-free surface and extended in this study to account for the contribution of point defects. Author

N65-19603# Army Electronics Labs., Fort Monmouth, N. J. Electronic Parts and Materials Div.

MAGNETIC PROPERTIES OF ELECTRODEPOSITED NICKEL-IRON-COBALT FILMS

Stanley Firestone Aug. 1964 28 p refs
(TR-2417; AD-609829)

The magnetic properties of 2000–4000 Å-thick nickel–iron–cobalt films for potential use in computer memories, the preparation methods for these films, and their evaluation are discussed. A variety of nickel–iron–cobalt alloy compositions were prepared to determine the particular alloy or group of alloys that would offer improvement over a straight nickel–iron alloy with regard to magnetic characteristics such as lower coercivity, lower anisotropy, greater transverse loop linearity, and increased flux level. Optimum magnetic properties were achieved with a 74.1% nickel, 23.2% iron, 2.7% cobalt alloy film. This plated composition offers very desirable properties for application in computer memory arrays. Author

N65-19621# Naval Research Lab., Washington, D. C. Metallurgy Div.

DIFFUSION IN COLUMBIUM RICH COLUMBIUM-TITANIUM ALLOYS WITH CONSIDERATION OF THE POSSIBILITY THAT THE DIFFUSION COEFFICIENT IS TIME DEPENDENT

T. C. Reuther, Jr. 14 Dec. 1964 173 p refs
(NRL-6221; AD-609870)

Interdiffusion was studied in Cb vs Cb 8.5 at.% Ti and Cb vs Cb 38 a/o Ti couples at temperatures of 1300° to

2000° C and for times of 0.1 to 1000 hours. The electron microprobe was used to obtain the penetration curves. Marker displacement toward and the development of porosity within the alloy at 1800° and 2000° C demonstrate that a vacancy mechanism is operative in this system. Porosity was also observed at 1500° C. At 1500° C for anneal times extending from 10 to 1000 hours for the more dilute alloy and from 10 to 120 hours for the 35 a/o Ti alloy, the interdiffusion coefficient D computed by the Boltzmann–Matano analysis is determined to be independent of time. Author

N65-19629# Army Materials Research Agency, Watertown, Mass. Materials Engineering Div.
DEVELOPMENT OF A STRUCTURAL URANIUM ALLOY
Jacob Greenspan and F. J. Rizzitano Sep. 1964 14 p refs (AMRA-TR-64-28; AD-609554) CFSTI: $0.50

A uranium alloy is described, and data are given on thermal history and on mechanical behavior and how it is affected by certain variations in alloy content. The range in property values thus presented was considerable. The work described is associated with possible applications of depleted uranium for structural purposes. Author

N65-19636# Joint Publications Research Service, Washington, D. C.
STRUCTURE AND PROPERTIES OF HEAT-RESISTING ALLOYS
S. T. Kishkim et al 18 Mar. 1965 38 p refs Transl. into ENGLISH from the book "Issledovaniya Struktury i Svoystv Zharoprochnykh Splavov" Moscow, Lenin Aviation Inst., 1964 p 14–19, 29–42, 56–65
(JPRS-29180; TT-65-30538) CFSTI: $2.00

The effect of short-duration superheating on the hardness, strength, plasticity, and durability of heat-resisting alloys is discussed in the first article. The second concerns the effect of sodium on heat-resisting alloys and indicates that observed structural and property changes in the surface layer of the alloy are mainly due to impurities in the sodium. The third article discusses an X-ray study of boundary zone oxidation and recrystallization processes in nickel-based alloy turbine parts and indicates the need to develop protective coatings to prevent oxidation of the surface layers of gas turbine blades. The fourth article demonstrates that, in a number of cases, the physicochemical properties of heat-resisting alloys may be improved by diffusion saturation with metals. The role of residual stresses in the surface layer of the alloy is studied, and the improved properties are explained by changes in the structural and energy state of the boundary zones of the alloy. M.P.G.

N65-19637# Joint Publications Research Service, Washington, D. C.
MARAGING STEELS AND ALLOYS
10 Mar. 1965 37 p refs Transl. into ENGLISH from Metalloved. i Term. Obrabotka Metal. (Moscow), no. 11, Nov. 1964 p 2–24
(JPRS-29054; TT-65-30472) CFSTI: $2.00

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N65-19638 Joint Publications Research Service, Washington, D. C.
THE MARTENSITE TRANSFORMATION IN MARAGING STEELS
A. P. Gulayev and N. I. Karchevskaya *In its* Maraging Steels and Alloys 10 Mar. 1965 p 1–6 refs (See N65-19637 09-17) CFSTI: $2.00

It was found that molybdenum lowers and cobalt increases the martensite range in 20% nickel steel. Further, in the presence of cobalt, molybdenum content can be increased to 5%. Hardness of annealed alloy steel does not depend on the ratio of austenite and martensite. Also, the hardness of noncarbon un-aged martensite coincides practically with the hardness of the initial austenite. In the alloys studied, hardness cannot be considered as a criterion of the degree of hardening. E.E.B.

N65-19639 Joint Publications Research Service, Washington, D. C.
MECHANICAL PROPERTIES OF MARAGING ALLOYS
M. D. Perkas *In its* Maraging Steels and Alloys 10 Mar. 1965 p 7–14 refs (See N65-19637 09-17) CFSTI: $2.00

Data are presented to show that the use of noncarbon alloys with aged martensite permits hardening with satisfactory ductility only by heat treatment. The effects of various amounts of titanium, aluminum, and cobalt on hardness of nickel alloy steel are discussed. It was found that an increase of the titanium content up to 0.83% resulted in hardening of the martensite whereas at a titanium content of 0.25% no hardening was observed from heating. The largest increase in hardness was observed for the alloy with 2.35% Ti. Aluminum increased considerably the hardness of martensite after annealing. E.E.B.

N65-19640 Joint Publications Research Service, Washington, D. C.
NEW LOW-CARBON AGE-HARDENABLE STRUCTURAL STEELS
D. A. Litvenenko and Yu. I. Stavitskiy *In its* Maraging Steels and Alloys 10 Mar. 1965 p 15–21 refs (See N65-19637 09-17) CFSTI: $2.00

Nickel alloy steels (9% to 20% Ni) containing aluminum, titanium, or molybdenum jointly with cobalt were found to experience considerable hardening after a short tempering at 400° to 550° C, with maximum hardening occurring at 500° C. Also, it was observed that the hardening of steels with 9% nickel was accompanied by sharp impairment of plastic and viscous properties. Sulfur and phosphorus impair the mechanical properties of nickel alloy steels; consequently, these impurities should be kept below 0.010% of each. E.E.B.

N65-19641 Joint Publications Research Service, Washington, D. C.
ELECTRON MICROSCOPE STUDY OF THE AGING OF AN Fe-Ni-Al ALLOY
V. M. Kardonskiy and M. D. Perkas *In its* Maraging Steels and Alloys 10 Mar. 1965 p 22–27 refs (See N65-19637 09-17) CFSTI: $2.00

Separation of (Ni, Fe)Al and Ni_3Al occurs during aging in the alpha phase of the martensite. Hardening after aging at

350° to 450° C is not accompanied by noticeable changes in the alloy structure. At 500° C formation of regions of less than 20 Å of (Ni, Fe)Al was identified. At temperatures above 500° C, large separations of Ni_3Al were observed in addition to regions of (Ni, Fe)Al. These separations, however, were found to play no substantial role in the hardening of the alpha phase as a result of aging. E.E.B.

N65-19642 Joint Publications Research Service, Washington, D. C.
PROPERTY CHANGES DURING MARAGING OF Cr-Ni STEELS
V. B. Spiridonov, Yu. A. Skakov, and V. N. Iordanskiy *In its* Maraging Steels and Alloys 10 Mar. 1965 p 38–34 refs (See N65-1937 09-17) CFSTI: $2.00

During aging of chrome–nickel steels with martensite structure, alloyed with aluminum, copper, aluminum–molybdenum, and copper–molybdenum, it was noted that the aging was limited by diffusion, initially by the drift of dissolved atoms to dislocations under the action of stresses, and later by normal diffusion in response to the chemical gradient. The kinetics of hardening during aging is affected by the concentration and character of structural defects. E.E.B.

N65-19660# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
CORROSION OF TYPE 316 STAINLESS STEEL IN NaK SERVICE—A LITERATURE SURVEY
C. A. Zimmerman Feb. 1965 21 p refs
(Contract AT(10-1)-205)
(IDO-14651) CFSTI: $1.00

A literature survey of work on corrosion of stainless steel, especially Type 316, by NaK and sodium was made. In general, the Type 316 and Type 304 stainless steels should give good performance with NaK. The mechanisms which can lead to failure are attack by impurities at temperatures under 550° C, and carbide precipitation, sigma formation, and mass transfer at higher temperatures. Author

N65-19683# National Aero- and Astronautical Research Inst., Amsterdam (Netherlands).
THE EFFECT OF TEMPERATURE AND FREQUENCY ON THE FATIGUE CRACK PROPAGATION IN 2024-T3 ALCLAD SHEET MATERIAL
J. Schijve and P. de Rijk Jan. 1965 40 p refs Sponsored by Neth. Aircraft Develop. Board
(NLR-TR-M.2138; ICAF-298)

Tests were carried out at 20° C and 2000 cpm, at 150° C and 2000 cpm and at 150° C and 20 cpm. Three stress amplitudes and one mean stress were used. Results indicate a temperature effect as well as a frequency effect. Crack extension due to creep was considered, a few provisional results being presented. Results are analysed and compared with relevant data from the literature. Author

N65-19729# Union Carbide Corp., Kokomo, Ind. Technology Dept.
PROPERTIES OF "HAYNES" ALLOY Cb-753 Developmental Report
M. Schussler 1 Mar. 1965 40 p refs

Cold-rolled sheet or cold-swaged rod of HAYNES alloy Cb-753 (columbium–5% vanadium–1.25% zirconium) recrystallizes to a fine grain size at a temperature of 2200° F. The microstructure consists of a columbium–vanadium–zirconium solid solution containing dispersed particles of zirconium oxide, ZrO_2, in two crystallographic forms. The alloy possesses excellent bend and Olsen cup ductility. It is readily machined using practices similar to those developed for other moderately high-strength columbium-base alloys. Tensile properties were determined on sheet and rod specimens over the temperature range from room temperature to 2400° F on recrystallized material. The short-time tensile properties determined at standard strain rates are excellent over this temperature range. On a yield strength-to-density basis and on an ultimate strength-to-density basis, HAYNES alloy Cb-753 has higher strength properties than many other highly fabricable columbium-base alloys. Author

N65-19845*# Astro Research Corp., Santa Barbara, Calif.
COMPRESSIVE STRENGTH OF BORON-METAL COMPOSITES
H. Schuerch Washington, NASA, Apr. 1965 24 p refs (Contract NASw-652)
(NASA-CR-202) CFSTI: HC $2.00/MF $0.50

The compressive strength and failure mechanisms of an idealized composite material are analyzed. A method of predicting, theoretically, the compressive strength and failure modes of an idealized composite material is developed. The method is applied to a boron fiber–magnesium matrix composite and predicted strength values are compared to experimental data. Author

N65-19865*# Boeing Co., Seattle, Wash. Aero-Space Div.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Progress Report No. 3, Oct. 20, 1964–Jan. 11, 1965
[1965] 49 p refs
(Contract NAS7-276)
(NASA-CR-57474) CFSTI: HC $2.00/MF $0.50

The purpose of this program is to develop a technique for hot extruding MgO and to determine the effect of hot extrusion on MgO with preliminary evaluations on other oxide bodies. Extrusion analysis shows that cracking should be reduced by slower cooling and relieving constraining of the ceramic by the can. Original large grain boundaries approximately parallel to the extrusion axis apparently slide during extrusion and result in preferential crack sites. Substantial grain elongation occurs during extrusion. The extruded body is nearly completely recrystallized giving a grain size much smaller than just prior to extrusion, and in fact smaller than in the starting billet. Very large grains are reduced much more than smaller ones, but do not produce as small an extruded grain size as a body of much smaller starting grain size. Dense MgO, MgO–NiO, and MgO–Al_2O_3 bodies show similar extrusion grain size, and highly oriented texture. MgO–CaO and MgO–ZrO_2 bodies are much more resistant to high temperature deformation. Increasing the extrusion temperature from 2100° to 2400° C did not significantly change grain size, orientation, or densification in MgO, MgO–NiO, or MgO–Al_2O_3 bodies. Author

N65-19874*# Aerojet-General Corp., Azusa, Calif. Chemical Products Div.
RESEARCH ON PROCESSES FOR ULTILIZATION OF LUNAR RESOURCES Quarterly Report, 16 Oct. 1964–15 Jan. 1965
S. D. Rosenberg, G. A. Guter, F. E. Miller, and R. L. Beegle Jan. 1965 50 p refs *Its* Rept.-0765-03-2
(Contract NAS7-225)
(NASA-CR-57484) CFSTI: HC $2.00/MF $0.50

Two successful runs were completed with the silicate-reduction furnace. Both an acid basalt and a granite were reduced

with methane gas; good material balances were obtained. Further modification of the methane inlet tubes is suggested. The first long duration run (60 days) with the carbon monoxide reduction apparatus was completed under a variety of conditions while maintaining satisfactory conversions and product yields. No apparent change in catalyst activity was noted.
Author

N65-19917*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SOLUBILITY OF IRON, NICKEL, AND COBALT IN LIQUID POTASSIUM AND EFFECT OF OXYGEN GETTERING AGENTS ON IRON SOLUBILITY
James H. Swisher Washington, NASA, Mar. 1965 13 p refs
(NASA-TN-D-2734) CFSTI: HC $1.00/MF $0.50

The solubility of iron, nickel, and cobalt in potassium was studied in the temperature range 941° to 1328° K. The cobalt solubility was less than 5 parts per million at the highest temperature. The equilibrium solubility obtained for alpha iron and nickel can be described by the following equations:

$$\log \text{ppm alpha iron} = 8.193 - 6166/T$$

$$\log \text{ppm nickel} = 3.89 - 3040/T$$

where T is the temperature in °K. The solubility data were determined by sampling the potassium at the test temperature using a dissimilar metal cup. The equation for iron was determined by using molybdenum sampling cups; however, the observed iron solubility was found to be strongly dependent on the cup material. This dependence was correlated with the oxygen gettering ability of various cup materials. Author

N65-19932*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
A STUDY OF SELECT CERAMIC OXIDE COMPOSITIONS AS HIGH TEMPERATURE (1600–2100°K) THERMAL ENERGY STORAGE MATERIALS Final Report, Feb. 1962–Feb. 1963
E. F. Batutis 5 May 1963 101 p
(Contract NAS5-826)
(NASA-CR-57410) CFSTI: HC $4.00/MF $0.75

An investigation of select ceramic oxide mixtures was conducted which included corrosion, materials testing and the development of a thermal conductance apparatus. This apparatus was designed to measure the thermal conductance of these oxide mixtures through their melting temperatures (as high as 2200° K). The corrosion tests have shown that these oxide mixtures are chemically compatible with certain refractory metals. All but a few of the failures in the containers were caused by poor welds or excessive grain growth. Analyses show good chemical compatibility between oxide mixtures and the refractory metals. Corrosion rate calculations based on the limited data indicate 2 to 4 mils loss in 10000 hours for the best combinations. The thermal conductance apparatus was fabricated, installed and calibrated. Calibration data are presented. The first oxide specimen is being fabricated and will be tested in the follow-on effort. The oxide specimen container geometry is rather difficult to fabricate and requires techniques to insure no voids in the oxide melt as well as to keep parasitic heat losses to a minimum. Author

N65-20030# Westinghouse Electric Corp., Blairsville, Pa.
THE PRIMARY WORKING OF REFRACTORY METALS Final Report, 1 Jun. 1963–31 Jul. 1964
D. R. Carnahan and V. DePierre (AFSC, Wright-Patterson AFB) Wright-Patterson AFB, Ohio, AF Mater. Lab., Nov. 1964 131 p refs
(Contract AF 33(616)-8325)
(AFML-TR-64-387; AD-612487)

Three-inch diameter billets of sintered W+2%ThO_2 and cast tungsten, molybdenum and columbium alloys were heated to temperature ranges of 2400° to 4000° F and extruded by a 700-ton instrumented press through 60°, 90° and 120° dies into 1.15 in.- to 1.75 in.-diameter bars. The extrusion techniques were evaluated by correlating deformation loads and extrusion properties with processing variables. Die load data were evaluated by the relation, die load divided by cross-sectional area of the upset billet equals an extrusion factor K_d multiplied by the natural logarithm of the reduction ratio. The following relationship was established between the extrusion factor and extrusion temperature:

$$\ln K_d = \ln K_o - mT$$

where K_d is extrusion factor at temperature T; K_o is extrusion factor at 0° F and m = constant for the alloy. Lowest deformation loads were obtained with 60° dies, glass lubricated billets, extrusion speeds below 4 inches per second and long billet heating times. In some cases 90° dies gave lower loads than 60° dies. In all cases 120° dies gave the highest loads. Deformation loads varied with billet material compositions and characteristics. Author

N65-20037# Stanford Univ., Calif. Dept. of Materials Science
DISLOCATION STRUCTURES IN DEFORMED AND RECOVERED TANTALUM Technical Report No. 1
T. W. Barbee, Jr. and R. A. Huggins Nov. 1964 27 p refs
(Contract Nonr-225(34))
(DMS-64-25; AD-609000)

By use of transmission electron microscopy, it was found that the deformation structures formed in tantalum, strained at temperatures between 25° and 1000° C, are comparable to those found in iron on the basis of homologous deformation temperatures. Several observations pertaining to the distribution of tangles at low strains, the types of tangles formed, the mechanisms of tangle formation, and the formation of deformation cell structure from tangles are also reported. Author

N65-20044# Illinois Univ., Urbana.
MICRODYNAMICS OF PLASTIC FLOW AT CONSTANT STRESS
J. J. Gilman Feb. 1965 27 p refs
(Contract Nonr-3985(06))
(TR-1; AD-612157)

Arguments are presented which conclude that the mean density of mobile dislocations in a crystalline solid increases linearly with plastic strain for small strains and decays exponentially for large strains, all at constant stress and low temperatures. The resulting analytic expression combined with the strain-rate equation can be integrated explicity in terms of tabulated exponential integral functions. This creep equation has a general form that is consistent with many experiments, and detailed comparison with a particularly well-documented experimental curve yields quantitative agreement. The present arguments together with previous ones yield a strain-rate equation which generates both stress–strain and strain–time curves that are good reproductions of experimental observations. Author

N65-20046# Case Inst. of Tech., Cleveland, Ohio. Dept. of Metallurgy
INTERFACE MOTION IN PHASE TRANSFORMATIONS. BAINITE TRANSFORMATIONS IN HYPOEUTECTOID STEELS
R. H. Goodenow, R. H. Barkalow, and R. F. Hehemann Feb. 1965 33 p refs
(Contract Nonr-1141(15))
(TR-2; AD-611092)

Kinetic and structural aspects of bainite formation were studied by stepped transformation experiments. Growth of lower bainite stops if the temperature is raised to the upper range, and upper bainite either stops growing or grows at a rate substantially below that of lower bainite when the temperature is reduced suddenly to the lower range. It is concluded that the internal structural differences which characterize upper and lower bainite exert a significant influence on the rate at which these products develop. In the steels studied, lower bainite plates thicken from one side only. These plates exhibit substructural units oriented at an angle to the growth direction which appear to nucleate at the immobile side of the plates. Edgewise growth rates measured on the hot stage thus may reflect primarily the rate of nucleation of these substructural units. A similar situation may prevail in the growth of upper bainite needles. Author

N65-20053# Stanford Univ., Calif. Div. of Engineering Mechanics
STRESS STRAIN RELATIONS FOR STRAIN RATE SENSITIVE ELASTIC PLASTIC MATERIALS Contract Report No. 1
J. M. Kelly Feb. 1965 37 p refs
(Contract DA-04-200-AMC-659(R))
(TR-152; AD-612009)

Extensions of the Sokolovsky–Malvern theory of strain rate dependent plasticity are proposed. These extensions are based on concepts of strain dependent viscosity and of hereditary integral viscosity, and are based on both the linearly viscoplastic constitutive equation and on the exponentially viscoplastic one. The basic tests—creep, relaxation and constant strain rate—are examined, and the application of the theories to wave propagation is discussed. Author

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N65-18869# Rock Island Arsenal Lab., Ill.
ALUMINUM COMPLEX SOAPS AS THICKENERS FOR MULTI-PURPOSE GREASE
Max T. Fisher 21 Dec. 1964 22 p refs
(RIA-64-3160; AD-610560) CFSTI: $0.75

The reaction of aluminum isopropylate with mixtures of fatty acids and other organic acids in a mutual solvent is the preferred method of forming complex soaps. Of the 17 different lower molecular weight organic acids complexed with an aluminum soap, an aluminum benzoate-soap complex showed the best thickening efficiency and highest dropping point. The effects of benzoate to soap ratios, preformed complex vs in situ preparations, solvent effects on in situ preparations and additive, thickener concentration and dispersion effects were evaluated on aluminum benzoate-soap complex greases made with 74 SUS at 100° F oil. Author

N65-18939*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
CHARACTERIZATION OF A BIREFRINGENT MATERIAL FOR USE IN PHOTOELASTO-PLASTICITY
G. A. Gurtman, W. C. Jenkins, and T. K. Tung Jan. 1965 71 p refs
(Contract NASw-926)
(NASA-CR-57192; SM-47796) CFSTI: HC $3.00/MF $0.75

An experimental program was undertaken to determine the material's optical and mechanical behavior at room temperature. Tests were performed in both uniaxial and biaxial stress fields. Techniques and instrumentation employed are described in detail. Two analytic expressions were formulated to describe the material's mechanical behavior. One relates stress and strain at constant strain rate and the other correlates current values of stress and strain in the material with the stress and strain rates. The material's birefringence was found to be linear with principal strain difference for vanishingly small strain rates, and the isoclinics were found to aline themselves with the principal stress directions. Recommendations are made to show how the material might be applied in photoelastoplastic studies, and areas requiring further study are discussed. Author

N65-19022# General Electric Co., Evendale, Ohio. Advanced Engine and Technology Dept.
INFLUENCE OF STRESS CORROSION ON STRENGTH OF GLASS FIBERS
D. L. Hollinger, W. G. Kanetzky, and H. T. Plant 30 Nov. 1964 21 p refs
(Contract Nonr-4486(00)(X))
(BMPR-4; AD-609985)

Static fatigue tests at liquid nitrogen temperature were completed on virgin E-glass single filaments. In these tests, fibers approximately 0.0005-inch diam were dead-loaded in tension while at −196° C and maintained at that temperature for at least 1.7×10^5 seconds. Loads were varied within the high stress region from 400 000 to 650 000 psi. No static fatigue failures were observed under these conditions, even though the stress range was high enough to cause immediate failure of some fibers upon load application. This is in distinct contrast to the behavior observed at room temperature in normal humidity where delayed failures occurred over several decades of time with stress level ranging from 200 000 to 400 000 psi. Author

N65-19085# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN INVESTIGATION OF FLUORIDE OPTICAL GLASSES
P'ei-Cheng Teng 29 Jan. 1965 22 p refs Transl. into ENGLISH from Kuei Suan Yen Hsueh Pao (China), v. 2, no. 4, 1963 p 212–222
(FTD-TT-64-911/1+2+3+4; AD-611081)

A number of systematic experiments on the fluoride optical glasses were conducted, primarily glasses of the fluoride–phosphate systems. The vitrification regions were determined for these glasses; their physicochemical properties, such as refractive index, density, hardness, devitrifying ability, and chemical stability were studied; and laws of variation for these properties were established. The possible applications of these new grades of optical glasses are discussed. Author

N65-19129# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials
A CROSS LINKED POLYMER STANDARD First Report on Polymer Selection
W. G. Knauss Jun. 1964 8 p
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-5; AD-611377)

The purpose of a program for the selection of cross-linked polymer standards is outlined. Six possible standard materials from a list of twelve candidates were selected. It has been tentatively established to choose two materials, one with a low glass transition temperature ($T_g \leq 70°$ C) to study the rubber-like behavior from both the continuum-mechanical and molecular standpoints and, the other, a polymer with a relatively high glass transition temperature ($0° \leq T_g \leq 20°$ C) for studying relaxation phenomena and for use in experimental and theoretical stress analysis investigations. Remaining properties required of the standard material are stress optical sensitivity for experimental stress, optical clearness, no crystallization, chemical stability, ease of manufacture, and good reproducibility with reasonable care of preparation. E.E.B.

N65-19130# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials
A CROSS LINKED POLYMER STANDARD Second Report on Polymer Selection
W. G. Knauss Dec. 1964 8 p refs
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-9; AD-611380)

In a previous report the purpose of the program to select or develop a cross-linked polymer standard was outlined. The essence of that report was the selection of 6 possible standard materials from a list of 12 material candidates. The present report summarizes the pertinent findings on three of the selected materials—Solithane 113, a Thiokol-produced polyurethane prepolymer cross-linked with castor oil; ethylene–propylene rubber; and butyl methacrylate. Author

N65-19256# Naval Research Lab., Washington, D. C. Chemistry Div.
FILAMENT-WINDING PLASTICS. PART 2: ROLE OF THE RESIN IN GLASS-FIBER-REINFORCED STRUCTURES UNDER TENSILE STRESS
F. S. Whisenhunt, Jr. 1 Dec. 1964 16 p refs
(NRL-6161; AD-609770) CFSTI: $0.50

A study was conducted on amine-cured epoxy resins and the effects on the ultimate burst strength of internally loaded glass-reinforced filament-wound vessels when used as the plastic matrices. The tensile properties of the matrix were changed by systematically altering the molecular structure of the amine-cured epoxy resin. It was found that resin tensile properties had an insignificant effect on the ultimate burst strength of a well-designed and well-fabricated vessel. However, it was also found that a matrix of good tensile properties improved the reliability of the burst pressure by providing a healing effect on minor winding errors. The glass stresses at burst of the test vessels were in the 400 000-psi range, which is about the ultimate tensile strength of bundles of "E" glass. A summary discusses the state of the art and unsolved problems relevant to the plastic matrix in glass-reinforced filament-wound vessels. In particular, the deleterious effect of voids on externally loaded structures and the necessity of removing these voids are discussed. Author

N65-19307# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile & Space Systems Div.
STUDY OF RESIDUAL STRESSES IN THICK GLASS FILAMENT REINFORCED LAMINATES Quarterly Progress Report No. 2, 30 Sep.–30 Dec. 1964
F. E. Stone and L. B. Greszczuk 30 Dec. 1964 48 p refs
(Contract NObs-90301)
(SM-47785; AD-609610)

The purpose of this program is to determine the presence and magnitude of residual stresses in thick wall fiberglass structures, and their effect on material properties. Residual stresses are reported for eight dispersed construction cylinders and eight all-hoop tape wound rings. Interlaminar shear strength and related trends for the cylinders are included. Four methods for analysis of residual stress are compared, and general orthotropic thermal effects analyzed. Author

N65-19473# Deutsche Forschungsanstalt für Luft- und Raumfahrt, Brunswick (West Germany). Inst. für Flugzeugbau
ABBREVIATED TEST PROCEDURES FOR THE DETERMINATION OF FATIGUE LIMIT AND LONG-TERM CREEP LIMIT OF GLASS FIBER REINFORCED SYNTHETIC MATERIALS [DIE ERMITTLUNG DER DAUERFESTIGKEIT UND DER ZEITSTANDFESTIGKEIT VON GLASFASERVERSTARKTEN KUNSTSTOFFEN MIT HILFE ABKURZENDER PRUFVERFAHREN]
G. Niederstadt 1964 36 p refs In GERMAN
(DFL-235)

A new time lapse procedure to evaluate fatigue and long-term creep measurements under consideration of progressive loads on glass fibers and synthetic resins did not concur with experimental values. Another method utilizing high temperature values in long-term creep measurements for 2-years duration showed good agreement in observations of glass enhanced synthetic fibers. Forced vibration resistance of glass fiber laminates was lower for the twisted fibers than for the ply fibers. Transl. by G.G.

N65-19551# Rensselaer Polytechnic Inst., Troy, N. Y. Dept. of Chemistry
COMPARISON OF EXTENDED POLYETHYLENE AND CHRYSOTILE ASBESTOS FRACTURE SURFACES
Theodore Davidson and Bernhard Wunderlich 15 Oct. 1964 16 p refs
(Contract Nonr-591(19))
(TR-7; AD-609608)

Striations in chrysotile asbestos and extended-chain polyethylene were compared. The polyethylene crystals were grown in laboratory, fractured, and then observed under an electron microscope. The striations in both substances were analyzed using a Cartesian-coordinates model for crack propagation. It was discovered that the structure of the fracture surfaces for the substances is similar. Analysis also supported the assumption that fracture proceeds in a manner that resembles random-walk propagation. J.M.D.

N65-19696# Forest Products Lab., Madison, Wis.
METHODS OF EVALUATING TENSILE AND COMPRESSIVE PROPERTIES OF PLASTIC LAMINATES REINFORCED WITH UNWOVEN GLASS FIBERS
Karl Romstad Aug. 1964 29 p refs Issued in cooperation with MIL-HDBK-17 Working Group on Plastics for Flight Vehicles of the Dept. of AF, Navy and Commerce
(Contracts NOw-19-64-8004; AF 33(657)63-358)
(FPL-052; AD-603486)

Methods of obtaining strength and elastic properties of plastic laminates reinforced with unwoven glass fibers were evaluated using the criteria of the strength values obtained and the failure characteristics observed. Variables investigated were specimen configuration and the manner of supporting and loading the specimens. Results of this investigation indicate that satisfactory tensile failures can be obtained by reinforcing the shank portion of the tension specimen with 1/32-inch sheet aluminum. Variation of tensile specimen geometry was inconclusive, with at least partial failures always occurring in the shank portion. Difficulty was encountered in trying to obtain accurate compressive strength data on the composite material comprising these laminates. Some acceptable compression failures were obtained using a 5 1/8-inch long specimen clamped at the ends and supported laterally by the standard FTM-406 jig, described in the Federal Test Method Standard No. 406. Failures varied for different laminates, indicating that resin properties may control failure when the material acts as a composite. Author

N65-19795# National Labs. for Research and Testing, Inc., Pawtucket, R. I.
INVESTIGATION OF SEAT BELT WEBBING SERVICE LIFE Final Report
Carl H. Stetson, Jr., W. George Parks, Roger Genest, and Frank Katz Sep. 1964 92 p
(Contract FAA/BRD-408)
(ADS-22)

The purpose of the project was to seek a sound technical basis for determining the ordinary service life of seat belt webbing. Various models of belts of different ages were collected in two climatic zones in the United States and subjected to a uniform testing procedure. The laboratory tests showed that of 399 seat belt samples tested, 42% failed to meet minimum strength requirements. Cotton webbing belts showed a higher incidence of failure than belts made with synthetic fiber webbing. Laboratory tests showed more assembly than webbing failures. The performance of all cotton belts tested leads to the conclusion that cotton webbing should not be used in aircraft safety belts. We recommend raising the minimum strength requirements for both webbing and assemblies. We recommend improved administrative procedures for the enforcement of minimum aircraft safety belt standards. Author

N65-19855*# National Academy of Sciences—National Research Council, Washington, D. C.
CONFERENCE ON ELECTRICAL INSULATION Annual Report, 1964
R. G. Fitzgerald et al 1964 154 p refs Conf. held at Cleveland, 11–14 Oct. 1964
(Contracts NSR-09-012-902; DA-31-124-ARO(D)-22)
(NASA-CR-57357; NAS-NRC-1238) Available from NAS-NRC: $5.00; CFSTI: HC $5.00/MF $1.00

Reports on electric insulation include (1) fabrication and insulation properties of dielectric materials, and of oxide and organic thin films; (2) electric conductivity of transformer oil and polyethylene; (3) effects of ac corona and gamma irradiation on conductivity; and (4) electric field and dielectric strength of resin, glass, and high polymers. J.M.D.

N65-19921*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PRELIMINARY INVESTIGATION OF FILAMENT-WOUND GLASS-REINFORCED PLASTICS AND LINERS FOR CRYOGENIC PRESSURE VESSELS
Morgan P. Hanson, Hadley T. Richards, and Robert O. Hickel Washington, NASA, Mar. 1965 30 p refs
(NASA-TN-D-2741) CFSTI: HC $2.00/MF $0.50

A preliminary investigation of the strength characteristics of filament-wound glass-reinforced plastic (FRP) materials was made at temperatures of 75°, −320°, and −423° F. The material was tested in the form of bidirectionally wound sheet material, unidirectionally wound Naval Ordnance Laboratory (NOL) type rings and bidirectionally wound cylinders. Also, a preliminary investigation of metallic and polymeric liners was made in FRP pressure vessels under cyclic strain of 2 1/2% at a temperature of −320° F. The ultimate strength of FRP materials at −320° and −423° F was significantly higher than that at room temperature. For example, strength increases ranging from 21% to 61% were noted for the cryogenic temperatures depending on the material and type of test specimen. The materials were found to be relatively insensitive to sharp notches. A preliminary investigation of liner materials and liner configurations indicated that aluminum foil liners having some type of provision for mechanical elastic extensibility show promise for use as permeability barriers in FRP pressure vessels subjected to cyclic pressurization resulting in strains of 2 1/2%. In general, plain metallic liners or plain polymeric liners were found to be unsatisfactory. Author

N65-20022# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A METHOD OF PREPARING A FAST-SETTING CEMENT
L. M. Pozin, I. M. Al'shits, and N. M. Grad 19 Feb. 1965 4 p Transl. into ENGLISH from Russian Patent no. 157749 (Appl. no. 752843/23-4), 22 Nov. 1961 2 p
(FTD-TT-64-968/1; AD-611858)

A method is proposed for the preparation of fast-setting cement by the introduction of zinc powder into a polyester tar in the ratio of 1 part by weight of polyester tar to 5.5 parts by weight of zinc powder. The cement hardens at room temperature in 15 to 30 minutes. The density of the mixture after hardening is 4.3 g/cc. Brinell hardness is 10 kg/sq. cm, and the impact load limit is 50 kg/cm. E.E.B.

N65-20023# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF CONTACTLESS CHECK OF NONMETALLIC COATINGS ON A METALLIC BASE
A. A. Naumov, V. S. Vikhman, and K. S. Plotnikov 2 Mar. 1965 4 p Transl. into ENGLISH from Russian Patent no. 158683 (Appl. no. 810861/26-10), 29 Dec. 1962 1 p
(FTD-TT-64-969/1; AD-611857)

The proposed method makes possible the simultaneous determination of coating thickness and extent of continuity. The thickness is measured from the difference in characteristic radiation of the metallic substrate and of the nonmetallic coating, excited by a radioactive source. The presence of a discontinuity is determined by the gas discharge from the ionized air-gap. E.P.V.

N65-20122# Princeton Univ., N. J. Frick Chemical Lab.
THERMOELASTICITY AND CHAIN CONFIGURATION FOR RUBBER LIKE NETWORK POLYMERS
Mitchel C. Shen and Arthur V. Tobolsky (N. Am. Aviation Sci. Center) Mar. 1965 23 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-85; AD-612084)

The retractive force, F, in a stretched rubber network is mainly entropic in origin, but may also arise partially from an energetic contribution F_e. The problem considered is how

to relate the relative energetic contribution F_e/F to stress–temperature measurements at constant length. A new approximate relation is derived which differs somewhat from that currently used. According to present theories of rubber elasticity, F_e/F is related to the temperature dependence of the mean square end-to-end distance of the polymer chain in free space; or equivalently, to the energy difference between rotational isomers of the chain conformations. These theories require that the relative energetic contribution be independent of elongation. New experimental evidence and data in the literature give a constant value of F_e/F only in the approximate extension range $1.4 < \alpha < 3.0$. It is to be hoped that in this range thermoelastic measurements relate directly to the energetics of chain conformation, and that the assumption of the absence of intermolecular interaction remains essentially valid. The lack of constancy of F_e/F at extensions below 1.4, however, is not fully explained as yet by any theory. Author

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N65-18621# Pennsylvania Univ., Philadelphia.
THE STUDY OF MATHEMATICAL MODELS FOR SELF-ORGANIZING SYSTEMS Final Report
Griffiss AFB, N.Y., RADC, Jan. 1965 241 p refs
(Contract AF 30(602)-3030)
(RADC-TDR-64-328; AD-610740)

Emphasis of the work is concentrated on three of the more promising models of self-organizing systems (SOS), namely, the cellular model, the linear statistical model and the list structure model. The discussion of the cellular model describes experiments in a two-dimensional rectangular space initially containing binary elements. The experiments gave insight into rules of element behavior that lead to stability and pattern formation. The linear statistical predictor provides a method for determining the structures of time-varying systems within a behavioral class. The list structure model began with an examination of state classes and regular expressions. It became clear early in the study that a primary prerequisite was a language suited to description of such a model and capable of being programed on a computer. It was demonstrated that the second-order predicate logic was a suitable language. Author

N65-18639# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THEORY OF OPTIMAL PROCESSES TO FUNCTION APPROXIMATION PROBLEMS
V. G. Boltyanskiy 25 Mar. 1963 21 p refs Transl. into ENGLISH from Tr. Mat. Inst., Akad. Nauk SSR (Moscow), no. 60, 1961 p 82–95
(FTD-TT-63-152/1+2+4; AD-402466)

The problem posed is that of finding the function x(t) which will minimize the bivariate function, $F = \int_a^b f(x(t), y(t))\,dt$; the kernel must be continuous in the range $a \leq t \leq b$, and x(t) must be continuous and differentiable up to the n^{th} order and must satisfy Lipshitz' condition with constant α. Conditions under which solutions exist, and the nature of the solutions, are determined through the method of optimal processes. An application to highway design is presented, where x(t) is the highway profile, y(t) is the contour of the terrain, and the road inclination is nowhere more than α. J.M.D.

N65-18655# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A CONCEPT OF SOLVING DIFFERENTIAL-DIFFERENCE EQUATIONS WITH CONSTANT COEFFICIENTS
A. P. Velikiy 28 Jan. 1965 8 p refs Transl. into ENGLISH from Sibirskiy Mat. Zh. (Moscow), v. 5, no. 1, 1964 p 34–38
(FTD-TT-64-851/1; AD-610650)

It is shown in this report that the solving of differential–difference equations of specific class can be presented in form of a sum of two components, the first of which is a solution of a certain difference equation, and the second, the sum of solutions of a certain recurrent system of differential equations. Such a concept allows accurate solutions of differential–difference equations to be found without resorting to the determination of roots of corresponding transcendental characteristic equations. A concrete example is given. The proposed method appears to be one of the variants of a combination of a known step method and a Laplace transform. Author

N65-18670# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
CHARACTERISTIC FORMULATION FOR NON-PERIODIC SOLUTIONS OF MATHIEU'S EQUATION
Theodor Tamir and H. C. Wang Aug. 1964 37 p refs
(Contract AF 19(604)-7499)
(PIBMRI-1233-64; AFCRL-64-943; AD-610720)

A simple compact formulation is presented for the eigenvalue λ of the Mathieu differential equation $y'' + (\lambda - 2h^2 \cos 2\theta)y = 0$. The relations obtained thereby are employed to examine certain characteristic features of the solutions $y = e^{i\nu\theta}\sum c_n e^{2in\theta}$ in both stable (ν real) and unstable (ν complex) regions. In the vicinity of the boundaries ($\nu = m$ = integer) which separate these regions, the expressions derived for λ are nonsingular and continuous; at the boundaries, these expressions are identical to available expansions which become therefore special cases of a more general formulation. The results are used to determine the magnitudes of the harmonic coefficients c_n and the instability intervals. The latter are shown to be intimately related to restrictions on the complex value of the characteristic exponent ν. In addition, simple approximations that are suitable for perturbation problems (h^2 small) are derived for all the characteristic quantities. Author

N65-18675# Wisconsin Univ., Madison. Mathematics Research Center
SPECTRAL METHODS FOR A GENERALIZED PROBABILITY THEORY
Stanley P. Gudder Dec. 1964 27 p refs
(Contract DA-11-022-ORD-2059)
(MRC-528; AD-610451)

Let L be a full orthocomplemented lattice. A derivable is a σ-homomorphism from the Borel sets B(C) of the complex plane into L. A set A of simultaneous derivables is complete if a derivable $x \leftrightarrow A$ implies $x \in A$. Theorem 1—A complete set of bounded derivables is a commutative B*-algebra. Theorem 2—If x is a derivable and u a complex Borel function, then $\sigma(u(x)) = \bigcap \{cl\, u(E): x(E) = 1\}$. If u is continuous, then $\sigma(u(x)) = cl\, u(\sigma(x))$. If x is a derivable and m a state, the expectation $m(x) = \int \lambda m[x(d\lambda)]$. Theorem 3—The set $\{m(x)$: all states $m\}$ = closed convex hull of $\sigma(x)$. Defining a suitable topology on the set of bounded linear functionals X′ on the collection of bounded derivables X, it is shown that if X′ is metrizable, then the set of expectations is a compact convex subset of X′. It is indicated that this result does not hold in general. Author

N65-18676# Wisconsin Univ., Madison. Mathematics Research Center

REPRESENTATIONS FOR THE GENERALIZED INVERSE OF SUMS OF MATRICES

Randall E. Cline Nov. 1964 30 p refs

(Contract DA-11-022-ORD-2059)

(MRC-530; AD-610453)

Representations for the generalized inverse of the matrix sum $UU^* + VV^*$ are developed, where U and V are arbitrary matrices with complex elements. These representations are obtained using forms for the generalized inverse of partitioned matrices $A = [U,V]$. Corresponding representations are obtained for the matrix sum $U + V$ in which U and V satisfy the condition $UV^* = \theta$. Computational forms for constructing the generalized inverse of any matrix X by application of results obtained for $UU^* + VV^*$ are discussed. Author

N65-18677# Wisconsin Univ., Madison. Mathematics Research Center

REGULARITY THEOREMS FOR SOLUTIONS OF INITIAL-BOUNDARY VALUE PROBLEMS FOR LINEAR HYPERBOLIC EQUATIONS OF THE SECOND ORDER

Calvin H. Wilcox Nov. 1964 13 p refs

(Contract DA-11-022-ORD-2059)

(MRC-533; AD-610455)

This report deals with initial-boundary value problems for linear hyperbolic differential equations of the second order. Classes of solutions wFE (with finite energy) and solutions wLFE (with locally finite energy) for these problems were introduced in a previous paper; the existence and uniqueness of such solutions in arbitrary domains for appropriate classes of coefficients and data were proved. The proofs were based on a new a priori inequality, the "domain of dependence inequality." This report presents regularity theorems for solution wLFE, i.e., theorems which guarantee the existence of higher order derivatives. Sufficient conditions are given for the existence of both square-integrable and continuous derivatives of prescribed orders. In particular, the results yield simple sufficient conditions for the solution wLFE to be a classical solution. The results are based on new inequalities, generalizing the domain of dependence inequality, which involve higher order time and space derivatives. Author

N65-18687 Oslo Univ., Blindern (Norway). Inst. of Theoretical Meteorology

ON NUMERICAL INTEGRATION OF CERTAIN PARTIAL DIFFERENTIAL EQUATIONS BY MEANS OF THE "IMPROVED EULER-CAUCHY METHOD," PART II Final Report

Arnt Eliassen *In its* Studies in Numerical Weather Prediction and the Dyn. of Fronts Aug. 1964 32 p refs (See N65-18685 09-20)

The improved Euler-Cauchy method for numerical integration of ordinary differential equations is generalized to partial differential equations. The criteria for computational stability and the truncation errors are studied in connection with application to some simple, linear equations. The method has a built-in damping which increases with decreasing wavelength and increasing wave speed, and seems to be well suited for equations in time and one space coordinate. For equations in time and two space coordinates, however, a complication arises, and a shortening of the time step seems to be necessary in order to secure stability. Author

N65-18752 Joint Publications Research Service, Washington, D. C.

ON SOME CLASSES OF COMPLEX SYSTEMS. I.

I. N. Kovalenko *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 1–11 refs (See N65-18751 09-34) CFSTI: $6.00

An abstract model is proposed for the operation of complex systems beginning with a representation of the process of operation of a system as a sequence of characteristics which are random with respect to time characteristics of elementary operations. This model generalizes schemes investigated in mathematical theory of mass servicing, and is used for a generalized approach to problems of investigation of effectiveness of complex systems. Author

N65-18755 Joint Publications Research Service, Washington, D. C.

ON CERTAIN PROBLEMS OF MASS SERVICING WITH A LIMITED WAITING TIME

L. G. Afanas'yeva *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 37–51 refs (See N65-18751 09-34) CFSTI: $6.00

A mass servicing system is considered with a limited waiting time where the random variable which limits the waiting time has an arbitrary distribution. A limit solution is obtained for the system with a representative servicing time, the simplest input flux, and $n \geq 1$ servicing instruments. The procedure of an imbedded Markov chain is used to solve the problem for a Pal'movskiy input flux. Equations are formulated, and a procedure is indicated for their solution, for a system with one servicing instrument and an arbitrary servicing time. Author

N65-18756 Joint Publications Research Service, Washington, D. C.

STATISTICAL SIMULATION OF OPERATION OF A SECTION OF A METALLURGICAL COMBINE

A. A. Belostotskiy and Yu. F. Val'denberg *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 52–64 refs (See N65-18751 09-34) CFSTI: $6.00

A description is presented of a model of a section of a metallurgical combine considered as a mass servicing system; and with the help of a statistical simulation an investigation is presented on the processes which occur in the system. A description is presented of the simulation algorithm, the characteristics of the program, and the basic results of the simulation. Author

N65-18757 Joint Publications Research Service, Washington, D. C.

SOME OPERATIONS ON GRAPHS

A. N. Melikhov *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 65–77 refs (See N65-18751 09-34) CFSTI: $6.00

Operations are defined for combination, cross section, multiplication, composition, and addition on arbitrary graphs. Saturated graphs are investigated which find application in the theory of automatons. The construction of a saturated graph of arbitrary order is presented from a unit graph with the help of the summation operation. Author

N65-18758 Joint Publications Research Service, Washington, D. C.

ON SEARCHING FOR THE SHORTEST PATHS ALONG A GRAPH DURING VARIATIONS IN IT

A. V. Butrimenko *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 78–83 refs (See N65-18751 09-34) CFSTI: $6.00

Algorithms are discussed for searching for the shortest paths along a graph. With the help of introduction of integral functions on the edges of the graph, means are described for such a search during variation of the structure of the graph. The search is made step by step and, at each apex, values of the function are investigated only on the sides incidental to the given vertex. Author

N65-18759 Joint Publications Research Service, Washington, D. C.
THE MINIMAX PROBLEM IN SEARCH THEORY FOR A CONVEX-CONCAVE PAYOFF FUNCTION
I. N. Kuznetsov *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 84–102 refs (See N65-18751 09-34) CFSTI: $6.00

The worst a priori probability distribution p(x) is sought for which the average payoff $R = \int p(x)\, P(\phi,x)dx$ for optimal distribution $\phi(x)$ of a limited number of means $\Phi = \int \phi(x)dx$ has the least value. Looking for the distribution is done under the condition that the payoff function $P(\phi,x)$ is a monotonically increasing function ϕ, $\phi > 0$ which is convex in the interval $(0,\phi_1)$ and concave in the interval (ϕ_1,∞). Author

N65-18763 Joint Publications Research Service, Washington, D. C.
ON REPRESENTATION OF FUNCTIONS OF TERNARY LOGIC BY DISJUNCTIVE NORMAL FORMS
I. N. Bogolyubov and V. I. Varshadskiy *In its* Tech. Cybernetics, No. 6, 1964 3 Mar. 1965 p 131–146 ref (See N65-18751 09-34) CFSTI: $6.00

The problems of representation of functions of ternary logic by disjunctive normal forms, and the problems of minimization of disjunctive normal forms are investigated. Author

N65-18799# California Univ., Berkeley. Electronics Research Lab.
ON THE RELATION BETWEEN ORDINARY AND STOCHASTIC DIFFERENTIAL EQUATIONS
Eugene Wong and Moshe Zakai (Sylvania Elec. Prod., Inc., Waltham, Mass.) 11 Aug. 1964 38 p refs
(Grant AF-AFOSR-139-64)
(Rept.-64-26; AD-609826)

The following problem is considered in this paper: Let x_t be a solution to the stochastic differential equation: $dx_t = m[x_t,t]dt + \sigma[x_t,t]dy_t$ where y_t is the Brownian motion process. Let $x_t^{(n)}$ be the solution to the ordinary differential equation obtained from the stochastic differential equation by replacing y_t with $y_t^{(n)}$ where $y_t^{(n)}$ is a continuous piecewise linear approximation to the Brownian motion and $y_t^{(n)}$ converges to y_t as $n \to \infty$. If x_t is the solution to the stochastic differential equation the sequence of the solutions $x_t^{(n)}$ does not generally converge to x_t; however, $x_t^{(n)}$ converges in the mean to the solution of another stochastic differential equation which is $dx_t = m[x_t,t]dt + 1/2\sigma[x_t,t](\delta\sigma[x_t,t]/\delta x_t)dt + \sigma[x_t,t]dy_t$. Author

N65-18854# Michigan Univ., Ann Arbor. Dept. of Communication Sciences
TOWARD A HOMOLOGICAL ALGEBRA OF AUTOMATA II. 2: A NOTE ON SOME WELL KNOWN FUNCTORS OF AUTOMATA
Yehoshafat Give'on Jan. 1965 30 p refs *Its* Rept.-06689, 03105-33-T
(Contract Nonr-1224(21); Grant DA-ARO(D)-31-124-G588)
(AROD-4043-10; AD-458295)

The report provides a suitable definition of homomorphisms of abstract automata (i.e., of state diagrams with an arbitrary fixed input monoid W) yields by category (denoted by Λ_W). The naturalness of the application of category theory to the study of automata follows from the fact that many, if not most, of the processes employed in automata theory turn out to be functors of or into Λ_W. This observation, which is reviewed in the present paper, has led the author to experiment with a more thorough application of the category theory approach to Λ_W. The results of this application are presented in the series of papers under the common title *Toward A Homological Algebra of Automata*. Author

N65-18903# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
PATHS IN POLYHEDRA, II
Victor Klee Oct. 1964 26 p refs *Its* Math. Note No. 373 (DI-82-0383)

The paper is concerned with a hypothesis of Saaty involving the paths in polyhedra which are produced by variants of the simplex algorithm. An analysis of his hypothesis and some of its relatives leads to the study of four different types of paths in a polyhedron P and to estimates for the length of each type in terms of the dimension and number of facets of P. Of special interest are the W_v paths, which never return to a facet from which they have earlier departed. It is conjectured that for an arbitrary nondegenerate linear programing problem and an arbitrary choice of an initial vertex of the feasible region P, there is a sequence of admissible pivots (improving the value of the objective function at each stage) which leads by means of a W_v path to a critical vertex of P. The conjecture is proved for the case in which P is of dimension three. Author

N65-18930# Princeton Univ., N. J. Gas Dynamics Lab.
THE COMBINATORY INTEGRAL TRANSFORM AND ITS APPLICATION TO HEUN'S EQUATION
H. H. Chiu and S. I. Cheng Feb. 1964 35 p refs *Its* Rept.-678
(Contract AF 49(638)-1271; Grant AF-AFOSR-112-63)
(AFOSR-64-0899; AD-606090)

Combinatory integral transforms are used to obtain solutions to a certain class of Heun's equations and many classes of third-order equations. Combinatory transformation as used in this analysis involves the successive application of the Euler and the Laplace transforms in the proper combination. After developing several properties of the Euler and Laplace integral transforms and showing that neither the Laplace nor the Euler kernels alone will produce a useful adjoint equation for treating the Heun's equation with four singular points, the application of the combinatory transform is demonstrated. It is shown that a given Heun's equation may admit many types of integral solutions; for each type of integral solution, the kernel of the integral solution may vary due to possible different selection of the characteristic roots in each of the Euler transforms. M.P.G.

N65-18940*# Kent State Univ., Ohio. Dept. of Mathematics
ON COUNTING TOPOLOGIES Technical Report No. 4
S. D. Chatterji Oct. 1964 7 p
(Grant NsG-568)
(NASA-CR-57191) CFSTI: HC $1.00/MF $0.50

Let $\Omega_n = (1,2,...n)$. A collection of sets (0) = S of Ω_n forms a topology if

(1) $\phi, \Omega_n \in S$, ϕ = null set
(2) $0_1, 0_2 \in S \Longrightarrow 0_1 \cap 0_2$ and $0_1 \cup 0_2 \in S$

The count of the number f(n) of distinct topologies on Ω_n is developed through the application of set theory, change in

formulations to equivalent relationships on Ω_n, and further reductions. It is shown that the number of topologies is given by the expression

$$f(n) = \sum_{k=1}^{n} \pi_{n,k} \quad f_o(k)$$

where $\pi_{n,k}$ = the number of partitions of Ω_n into k disjoint nonempty subsets. E.E.B.

N65-18941*# Kent State Univ., Ohio. Dept. of Mathematics
ON TIME CHANGES IN A DIGRAPH Technical Report No. 3
T. N. Bhargava Jun. 1964 29 p refs
(Grants NsG-568; NSF G-18976)
(NASA-CR-57190) CFSTI: HC $2.00/MF $0.50

The object is to present a probabilistic model for analyzing changes through time in a binary dyadic relation on a finite set of points. The total relation on the set takes the form of an aggregate of directed binary dyadic relations between ordered pairs of points belonging to the set; equivalently, the total relation on the set can be represented by means of a digraph or an incidence matrix isomorphic with the total relation. Such a relation, changing in its structure as time proceeds, is a reasonable mathematical model, for example, for the evolution of interrelationships of the members of a social or any other group. A group of this kind is organized for a specific activity involving some sort of communication from one member to the other, and may be observed at successive discrete points in time generating statistics on the evolutionary process. Author

N65-18942*# Stanford Univ., Calif. Computer Science Div.
CONSTRUCTION OF NONLINEAR PROGRAMMING TEST PROBLEMS
J. B. Rosen and S. Suzuki 12 Aug. 1964 3 p
(Grant NsG-565)
(NASA-CR-57188) CFSTI: HC $1.00/MF $0.50

A procedure is described for the construction of test problems with known optimum solutions. The procedure is for a concave maximization subject to concave constraints. Such test problems are very useful for the test of nonlinear programing algorithms. E.E.B.

N65-18993# Columbia Univ., New York. Dept. of Mathematical Statistics
THE DISTRIBUTIONS OF SOME STATISTICS DEPENDING ON THE DEVIATIONS BETWEEN EMPIRICAL AND THEORETICAL DISTRIBUTION FUNCTIONS
Lajos Takács 21 Dec. 1964 15 p refs
(Contract Nonr-266(59))
(CU-49-64-Nonr-266(59); AD-610090)

Theorems obtained by generalization of the classical ballot theorem are shown to have many useful applications in the theory of order statistics. The random variable distribution, obtained previously by complicated computations, is derived easily through use of a simple combinatorial theorem of the distribution. E.E.B.

N65-19008# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
A CLASS OF LINEAR PROGRAMMING PROBLEMS REQUIRING A LARGE NUMBER OF ITERATIONS Mathematical Note No. 375
Victor Klee (Washington Univ., Seattle) Nov. 1964 23 p refs
(DI-82-0387)

A coordinate-free description of the simplex algorithm (for nondegenerate linear programing problems) is supplied, and is used to show that the number of iterations can be larger than was previously known. For $0 < m < n$, there is constructed a nondegenerate linear programing problem whose bounded $(n-m)$-dimensional feasible region is defined by means of m linear equality constraints in n nonnegative variables, and in which, after starting from the worst choice of an initial feasible vertex, $m(n-m-1)+1$ simplex iterations are required in order to reach the optimal vertex. It is conjectured that this is the maximum possible number of iterations (for arbitrary $0 < m < n$), but the conjecture is proved only for $n < m+4$. Author

N65-19013# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Applied Mathematics Research Lab.
DISTRIBUTION OF THE STUDENTIZED SMALLEST CHI-SQUARE, WITH TABLES AND APPLICATIONS
P. R. Krishnaiah and J. V. Armitage Dec. 1964 94 p refs
(ARL-64-218; AD-610072)

Let $x_1, \ldots, x_k$ be k independently distributed chi-square variates with n degrees of freedom, and let x_0 be another chi-square variate with m degrees of freedom distributed independently of the other x_i's. Then, the distribution of

$$v' = \frac{m \min(x_1, \ldots, x_k)}{n \; x_0}$$

is known to be the studentized smallest chi-square distribution. In this report, lower 10%, 5%, 2.5% and 1% points of the distribution of v are tabulated for $k = 1(1)12$, $n = 1(1)20$ and $m = 5(1)45$. Some applications of these tables are also discussed. Author

N65-19016# Massachusetts Inst. of Technology, Cambridge. Electronic Systems Lab.
ALGORITHM FOR SOLVING VOLTERRA INTEGRAL EQUATIONS MET IN PROCESS IDENTIFICATION
Edward P. C. Hsieh Aug. 1964 49 p refs
(Grant DA-ARO(D)-31-124-G-193)
(ESL-R-209; AROD-3365-2; AD-609864)

This report is concerned with the determination of the impulse response of a physical system as applied to the problem of identification of process dynamics in adaptive control systems. With input command signals whose characteristics are changing with time, an optimal control of the process can be achieved most effectively by altering the control characteristics at appropriate instants during the length of the operation. A general approach to the problem is chosen so that complete identification is obtained using only the normal input signals without relying on the injection of test signals. An effective procedure has been developed to process these measured data to obtain the entire impulse response. The proposed procedure, with some modifications and generalization of concepts, can be applied to the problem of designing the impulse response of an optimum linear system using minimum mean squared error criterion. Author

N65-19088# Stanford Univ., Calif. Computer Science Div.
NUMERICAL METHODS FOR SOLVING LINEAR LEAST SQUARES PROBLEMS. AN ALGOL PROCEDURE FOR FINDING LINEAR LEAST SQUARES SOLUTIONS.
G. Golub and Peter Businger 28 Aug. 1964 29 p refs
(Contract Nonr-225(37))
(CS-12; AD-608292)

A common problem in a computer laboratory is that of finding linear least squares solutions. These problems arise

in a variety of areas and in a variety of contexts. Linear least squares problems are particularly difficult to solve because they frequently involve large quantities of data, and they are ill-conditioned by their very nature. In this paper, stable numerical methods for handling these problems are considered. The basic tool is a matrix decomposition based on orthogonal Householder transformations. Author

N65-19099# State Univ. of New York, Stony Brook. Coll. of Engineering

ORTHONORMAL SERIES EXPANSIONS OF CERTAIN DISTRIBUTIONS AND DISTRIBUTIONAL TRANSFORM CALCULUS Fifth Scientific Report

A. H. Zemanian 15 Nov. 1964 40 p refs *Its* Rept.-22
(Contract AF 19(628)-2981)
(AFCRL-64-995; AD-610748)

A technique for expanding certain Schwartz distributions into series of orthonormal functions is devised. The method works for all the classical orthogonal polynomials and many other sets of orthogonal functions. This result is then used to generalize various standard integral transforms, which are based on orthogonal series expansions, to distributions. As specific examples, the following distributional transforms are developed: the finite Fourier, the Laguerre, the Hermite, the Jacobi, the Legendre, the Chebyshev, the Gegenbauer, and the finite Hankel transform of zero order. An application to the solution of differential equations is given. Author

N65-19258# Naval Research Lab., Washington, D. C. Mechanics Div.

NORMAL MODE THEORY FOR THREE-DIRECTIONAL MOTION

P. F. Cunniff and G. J. O'Hara 5 Jan. 1965 38 p refs
(NRL-6170; AD-611573)

Normal mode theory is applied to undamped linear elastic structures represented as lumped parameter systems undergoing translational motion in three directions. The derived equations are primarily concerned with the response of such structures subject to applied forces and base motions, and with the inertial forces required to calculate stress in each mode of vibration. Additional relationships are presented for special types of loading and for the effective mass acting in a given mode due to base motion. Similar equations are summarized in an appendix for structures with six directions of motion, namely, three translational directions and three rotational directions subject to prescribed assumptions. Author

N65-19303# New York Univ., N. Y. Lab. for Electroscience Research

AN ALGEBRAIC-GEOMETRIC TECHNIQUE FOR THE REALIZATION OF SWITCHING FUNCTIONS WITH m-out-of-n DECISION GATES Technical Report 400-101

Manush Raship Oct. 1964 41 p refs
(Grant AF-AFOSR-24-64)
(AFOSR-64-2496; AD-609505)

An algebraic-geometric technique is presented for the realization of binary switching functions with networks composed of m-out-of-n decision gates. An m-out-of-n decision gate is defined as a device that may be described by a threshold function whose weights and threshold are positive integers. An expansion theorem is proved that can produce a variety of gate configurations ranging between the two extremes of 2(n-1) stages of 3-input majority gates, and a 2-stage form composed of gates having a much greater number of inputs. For realization with two stages, the terms of the expansion theorem may be mapped on to one-half of a Karnaugh diagram. The map displays all possible combinations of terms which may be combined according to the m-out-of-n decision logic, and provides a basis for formalizing the initial step in a reduction procedure. Author

N65-19309# Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

A LAGRANGIAN FINITE DIFFERENCE METHOD FOR TWO-DIMENSIONAL MOTION INCLUDING MATERIAL STRENGTH Technical Report, 30 Sep. 1962-24 Jun. 1964

Walter Herrmann Kirtland AFB, N. Mex., AF Weapons Lab., Nov. 1964 104 p refs
(Contract AF 29(601)-4601)
(WL-TR-64-107; AD-609523)

One- and two-space dimensional finite-difference schemes for the Lagrangian numerical solution of problems in the motion of solids, including material strength, are presented. Two-dimensional rectangular cartesian or cylindrically symmetric problems may be handled. Results of sample calculations are appended to illustrate the effect of material strength. Author

N65-19311# Arcon Corp., Lexington, Mass.

REAL TIME COMPUTATION OF CONFIDENCE ELLIPSOIDS

Arthur Albert Dec. 1964 39 p refs
(Contract Nonr-4401(00))
(AD-609601)

A problem in sequential sampling from a Multivariate Normal distribution is solved. The problem is as follows: A sample is given of n observed values, y_i, each of which is a linear function of m constants and has a Normal distribution with variance σ^2. The vector of the m constant is X, and its least-square estimate is $\hat{X}$; G is a k × m matrix; ψ is defined as the matrix product GX and if it is estimatable, $\hat{\psi} = G\hat{X}$ which has a Multivariate Normal distribution with variance $\sigma^2 R$, where R is a known, nonsingular matrix. The ratio $(n - m)\ \hat{\sigma}^2/\sigma^2$ has an F-distribution with critical value $d(1 - \alpha)$ for the α level of significance. Each time the sample is increased—from size n to n + 1, and then from n + 1 to n + 2, etc.—the quantities $\hat{X}$, $\hat{\psi}$, R, and $d(1 - \alpha)$ must be recalculated; the report presents an efficient method for this recalculation. J.M.D.

N65-19312# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.

A METHOD FOR THE NUMERICAL INTEGRATION OF A SPECIAL CLASS OF SECOND-ORDER DIFFERENTIAL EQUATIONS

Robert F. Boylan Aug. 1964 25 p refs
(Contract AF 04(694)-553)
(R-463; AD-609219)

A numerical integration procedure is developed for solving systems of differential equations of the form $d^2\bar{y}/dx^2 = \bar{f}(x,y)$, where $\bar{f}$ and $\bar{y}$ are column vectors with N components. It is a self-starting method employing a final corrector in conjunction with the usual predictor and corrector. Equations for obtaining the solution at intermediate or special integration points are also provided. Computer simulations show the procedure to be as accurate as, and considerably more efficient than, the Gill-modified fourth-order Runge-Kutta scheme. Author

N65-19328# Joint Publications Research Service, Washington, D. C.

APPLIED AND MATHEMATICAL LINGUISTICS. DESCRIPTION OF A SYSTEM OF LINGUISTIC OBJECTS POSSESSING COMMON PROPERTIES

Yu. I. Levin 16 Mar. 1965 16 p refs Transl. into ENGLISH from Vopr. Yazykoznaniya, (Moscow), no. 4 Jul.–Aug. 1964 p 112–119
(JPRS-29141; TT-65-30522) CFSTI: $1.00

A mathematical representation is presented which considers phonemes as objects and determines the degree of similarity between the properties (hardness, softness, continuity, sonority, etc.) of sets of object phonemes. The proximity of the object phonemes and the assignment of weighted values to their properties are considered. M.P.G.

N65-19387# California Univ., Berkeley. Operations Research Center
SOME INEQUALITIES GOVERNING OPTIMUM CODE
T. C. Hu 23 Oct. 1964 16 p refs
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-64-27(RR); AD-610952)

Let an information source be given which generates messages consisting of sequences of letters $X_1, X_2, \ldots X_n$. Each letter X_i occurs with probability p_i. A combinatorial argument is used to study the case where α costs d dollars and the β costs d + 1 dollars where d is a positive integer. This case reduces to the Hoffman's case when d becomes infinite, and, for d = 1, approximates the dot-dash case of common usage. R.W.H.

N65-19389# Stanford Univ., Calif. Dept. of Statistics
AN EXACT ASYMPTOTICALLY EFFICIENT CONFIDENCE BOUND FOR RELIABILITY IN THE CASE OF THE WEIBULL DISTRIBUTION
M. V. Johns, Jr. and G. J. Lieberman 18 Dec. 1964 51 p
(Contract Nonr-225(53))
(TR-75; AD-609259)

This report presents a simple method for obtaining exact lower confidence bounds for reliabilities (tail probabilities) for items whose lifetimes follow a Weibull distribution where both the "shape" and "scale" parameters are unknown. These confidence bounds are obtained both for the censored and noncensored cases and are asymptotically efficient. They are exact even for small sample sizes in that they attain the desired confidence level precisely. The case of an additional unknown "location" or "shift" parameter is also discussed in the large sample case. Tables are given of exact and asymptotic lower confidence bounds for the reliability for sample sizes of 10, 15, 20, 30, 50, and 100 for various censoring fractions. Author

N65-19412# Washington Univ., Seattle. Dept. of Mathematics
ABSOLUTE EQUIVALENCE OF EXTERIOR DIFFERENTIAL SYSTEMS
Harold H. Johnson Dec. 1964 12 p refs
(Contract Nonr-477(15))
(TR-23; AD-609687)

Two exterior differential systems are absolutely equivalent if there exists a sequence of systems beginning with one and ending with the second in which for each adjacent pair one is a partial prolongation of its neighbor. Two kinds of numerical invariants are found, depending on the characters $s_0, s_1, \ldots, s_p$. Using Kuranishi's infinite analytic mappings, the last nonzero integer among $s_0, s_1, \ldots s_p$ is an absolute invariant. Other absolute invariants are computed from the sequence of prolongations of a given system. Author

N65-19437# Columbia Univ., New York. Dept. of Mathematical Sciences
A MOMENT PROBLEM
Lajos Takács 11 Nov. 1964 10 p refs
(Contract Nonr-266(59))
(CU-48-64-Nonr-266(59)MS; AD-610088)

An equation was derived for getting binomial probabilities from the expected values of the binomial coefficients. Such a probability, P(v = k), and the corresponding coefficient expectation, $E[\binom{v}{r}]$, are joined by the relation

$$E\left[\binom{v}{r}\right] = \sum_{k=r}^{\infty} \binom{k}{r} P(v = k).$$

The explicit equation for P(v = k) is a function of $\binom{v}{r}$, $E[\binom{v}{r}]$, and the limit of the r^{th} root of the expectation as r tends to infinity. Proof of the equation is obtained by using the probability generating function for P(v = k). J.M.D.

N65-19486# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
SERIES REPRESENTATION OF CONTINUOUS FUNCTIONS
M. Wachman Mar. 1965 26 p
(R65SD5)

A representation series is derived for a class of continuous function Φ on the t – interval I' = [0, 1]. If $\phi(t) \in \Phi$ on a subset σ of I' then

$$\phi(t) = \sum_{j=1}^{m} \sum_{v=0}^{\infty} \left[\sum_{i=0}^{v+1} \alpha_{i,v}(k) \bar{\phi}_j(k^{i+1}\tau_j) \right], \quad t \in \sigma \qquad (1.1)$$

where τ_j is defined by the continuous function $\tau_j = f_j(t) \in [0,1]$ for $t \in I'$, and $\sum_{j=1}^{m} \bar{\phi}_j(\tau_j) = \phi(t)$. It should be noticed that this representation series for continuous functions is more similar to the Taylor series representation for analytic functions than to the expansion of continuous functions using the concept of convergence in the mean. Since series (1.1) is a discrete point representation of a continuous function, one is immediately aware of the possibility of its application to the fields of numerical analysis and data processing. The representation series, in truncated form, is an extrapolation formula over a definite set of grid points. The grid points, $k\tau_j, k^2\tau_j, k^3\tau_j, \ldots$ are the points at which the known function values are taken. Author

N65-19511*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF VARIATIONAL PRINCIPLES, THE HAMILTON PRINCIPLE IN PARTICULAR, TO THE APPROXIMATE SOLUTION OF HYPERBOLIC DIFFERENTIAL EQUATIONS [O PRIMENENII VARIATSIONNYKH PRINTSIPOV, V CHASTNOSTI PRINTSIPA GAMIL'TONA, DLYA PRIBLIZHENNOGO RESHENIYA DIFFERENTSIAL'NYKH URAVNENIY GIPERBOLICHESKOGO TIPA]
V. I. Krylov and N. P. Keda Mar. 1965 8 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR, v. 8, no. 11, 1964 p 689–692
(NASA-TT-F-9296) CFSTI: HC $1.00/MF $0.50

A method of approximate solution is given in general form for combination initial- and boundary-value problems associated with hyperbolic differential equations. The method is based on a dimensional reduction analogous to that of the Hamiltonian principle in mechanics. The main difficulty in the hyperbolic, as opposed to the elliptic, case lies in estimating the approximation error and establishing the convergence conditions. The case of a uniform string held at both ends in free oscillation is analyzed as a numerical example, which suffices to demonstrate the merit of the method. Author

N65-19530# Rome Air Development Center, Griffiss AFB, N. Y. Research and Technology Div.
CONCEPTS RELATIVE TO SYSTEM EFFECTIVENESS
Julius Widrewitz Jun. 1964 26 p ref
(EME-TM-64-4; AD-609637)

This technical memorandum presents a definition of and mathematical model for measurement of system effectiveness. Improvements over existing definitions of system effectiveness are incorporated in the model. Author

N65-19538# Joint Publications Research Service, Washington, D. C.
ON THE THEORY OF SCHEDULING
V. S. Tanayev 16 Mar. 1965 7 p refs Transl. into ENGLISH from Dokl. Akad. Nauk Belorussk. SSR (Minsk), v. 18, no. 12, 1964 p 792–794
(JPRS-29138; TT-65-30519) CFSTI: $1.00

The determination of the matrix X which minimizes the function:

$$f(X) = \max_{1 \le u \le n} \left(\sum_{i=1}^{u} {}^{x}a_i + {}^{x}b_u\right).$$

is applied: to process n details on two machines A and B in the order AB under the assumption that no detail can be processed on one machine at a time, and that none of the machines can process more than one detail at a time; to process n details on one machine; to find the optimum schedule by which the details are processed on two machines in a sequence where D_i units of time must elapse from the instant when machine A begins processing the i-th detail, to the instant when machine B begins to process this detail; and to process N groups of details I, II, ..., J, ..., L ..., N in two interconnected work areas A and B in the order AB. G.G.

N65-19543# Argonne National Lab., Ill. Applied Mathematics Div.
A SPECTRAL THEORY FOR THE STATIONARY TRANSPORT OPERATOR IN SLAB GEOMETRY
Erwin H. Bareiss Dec. 1964 56 p refs
(Contract W-31-109-ENG-38)
(ANL-6940) CFSTI: $3.00

Patterned after the operational calculus of functional analysis, a spectral theory is constructed over a general function space for stationary transport operators in plane geometry as they occur in neutron theory, radiative transfer, and other areas. As an application, the general solution of the corresponding transport equations is given in closed form. It is shown that the spectrum of the isotropic transport operator consists of the union of a discrete spectrum of exactly two points, either real or pure imaginary, and a continuous spectrum which extends from ± 1 to $\pm\infty$ of the real axis. If the discrete spectrum of the anisotropic operator consists of two points only, as in practical applications, the spectrum has the same properties as in the isotropic case. Proof and additional properties of the spectrum are derived under the assumption that the scattering functions have the physically important form $f(\Omega,\Omega') = f(\Omega\cdot\Omega') > 0$. Author

N65-19544# France. Ministere de l'Air, Paris.
CONTRIBUTIONS TO THE THEORY OF TRANSPORT PHENOMENA [CONTRIBUTIONS A LA THEORIE DES PHENOMENES DE TRANSPORT]
Herbert Budd Serv. de Doc. Sci. et Tech. de l'Armement, 1964 88 p refs In FRENCH *Its* Publ. Sci. et Tech. No. 408

The exact solution of the Boltzmann equation in the approximation of relaxation time is given for externally applied forces, a band structure, and an arbitrary relaxation time. The method of energy gain is deduced from the Boltzmann equation by a technique of inversion of the operator of collisions. Using new methods, theories are presented for treating the problem of hot electrons, and the distribution function is calculated for galvanomagnetic effects in the case of hot electrons. Trans. by M.P.G.

N65-19594# Booz-Allen Applied Research, Inc., Bethesda, Md.
ON SAMPLE SIZE DETERMINATION Informal Report No. 2
May 1964 7 p
(Contract DA-18-108-CML-7174)
(Rept.-803-1-R14; AD-600308)

A frequent request made prior to sampling involves the determination of the appropriate sample size necessary to estimate population characteristics within a specified accuracy. Although the problem can be simply stated, the solution usually requires more a priori knowledge than is available. This informal memo suggests two approaches which could be used in estimating the mean value, μ, in a population containing N observations. The necessary assumptions are clearly stated. Author

N65-19610# Israel Inst. of Technology, Haifa. Dept. of Physics
ENERGY-MOMENTUM TENSORS Scientific Report No. 9
A. Peres 11 Aug. 1964 5 p
(Grant AF-EOAR-64-20)
(ARL-64-227; AD-608039)

The canonical energy–momentum quasi-tensor differs from the metric energy–momentum tensor density by a complete divergence. Therefore both expressions give the same value for the total energy and momentum of a closed physical system. Author

N65-19620# Uppsala Univ., (Sweden). Quantum Chemistry Group
QUANTUM THEORY OF MANY-PARTICLE SYSTEMS Annual Summary Report, Sep. 1, 1963–Aug. 31, 1964
[1964] 8 p refs
(Contract AF 61(052)-701)
(ARL-65-25; AD-610079)

A bibliography of 50 research reports and published papers on quantum theory of many-particle systems is listed. Topics pertain to perturbation theory, molecule orbitals, crystals, wavefunctions, and eigenvalue problems. J.M.D.

N65-19634# Harvard Univ., Cambridge, Mass. Cruft Lab.
AN EXPONENTIALLY CONVERGENT AND FINITE ALGORITHM FOR LINEAR INEQUALITIES
Yu-chi Ho and R. L. Kashyap Oct. 1964 10 p refs
(Contract Nonr-1866(16))
(TR-454; AD-609777)

In this report, we present an exponentially convergent and finite algorithm for determining x such that $Ax > 0$ for given A. Author

N65-19670# American Meteorlogical Society, Boston, Mass.
FUNCTIONS OF SEVERAL VARIABLE MATRICES [FUNCTIONS DE PLUSIEURS MATRICES VARIABLES]

J. A. Lappo-Danielevski Bedford, Mass., AFCRL, Jun. 1964 22 p Transl. into ENGLISH of "Memoires Sur La Theorie Des Systemes Des Equations Differentielles Lineaires" New York, Chelsea Publishing Co., 1953 p 115–134
(Contract AF 19(628)-3880)
(T-F-62; AD-453042)

Three sections of an apparently extensive paper are presented. One section treats the series of compositions of two second-rank arbitrary matrices, X_1 and X_2, such that

$$X_1 = \begin{Vmatrix} x_{11}^{(1)} & x_{12}^{(1)} \\ x_{21}^{(1)} & x_{22}^{(1)} \end{Vmatrix}, \quad X_2 = \begin{Vmatrix} x_{11}^{(2)} & x_{12}^{(2)} \\ x_{21}^{(2)} & x_{22}^{(2)} \end{Vmatrix}$$

In the second section, a discussion is given of functions of several matrices using the series of traces, the series of matrices and traces, and the meromorphic functions of matrices. In the third section, a matrix X, which is a function of two different matrices, U and T, is discussed, and formulas are derived for the elements of X. It is demonstrated that the function X defined by a derived series, is a meromorphic function of matrix U. D.E.W.

N65-19711# Purdue Univ., Lafayette, Ind. Instit. for Research
CONSISTENCY OF LEAST SQUARE ESTIMATORS OF COEFFICIENTS IN EXPLOSIVE STOCHASTIC DIFFERENCE EQUATIONS
Thomas Joseph Muench Aug. 1964 70 p refs *Its* Paper No. 71
(Contract Nonr-110(16))
(AD-609320) CFSTI: $3.00

The bias in the estimate of the coefficient α_i is expressed as a quotient of two determinants; two transformations are performed; and the limit of the quotient is evaluated by determination of the limit of each element in both determinants. The second problem considered is the generalization of Rubin's proofs which is accomplished by representing the n-lag process in vector form, and substituting matrix bounds for absolute values in Rubin's proofs for one leg. E.E.B.

N65-19765*# Stanford Univ., Calif.
EXISTENCE AND UNIQUENESS OF EQUILIBRIUM POINTS FOR CONCAVE N-PERSON GAMES
J. B. Rosen [1964] 28 p refs
(Grant NsG-565)
(NASA-CR-57255) CFSTI: HC $2.00/MF $0.50

A constrained n-person game is considered in which the constraints for each player, as well as his payoff function, may depend on the strategy of every player. The existence of an equilibrium point for such a game is shown. By requiring appropriate concavity in the payoff functions a concave game is defined. It is proved that there is a unique equilibrium point for every strictly concave game. A dynamic model for non-equilibrium situations is proposed, consisting of a system of differential equations which specify the rate of change of each player's strategy. It is shown that for a strictly concave game the system is globally asymptotically stable with respect to the unique equilibrium point of the game. Finally, it is shown how a gradient method suitable for a concave mathematical programing problem can be used to find the equilibrium point for a concave game. Author

N65-19800# Wisconsin Univ., Madison. Dept. of Statistics
SOME NOTES ON NON-LINEAR ESTIMATION
George E. P. Box Mar. 1964 33 p refs
(TR-25)

Iterative methods suitable for computer determination least-squares parameter estimates are described for nonlinear, multivariate regression equations. The basic consideration is finding ranges of parameter values in which the observed variable is an approximately linear function of the parameters; higher-order approximation is also discussed. Comparison of methods involves both the criterion of minimizing the sum of squared deviations between observed and theoretical values and the criterion of minimizing the variances of the parameter estimates. Comparisons are made in various worked examples in chemistry, using polynomial and exponential regression models. J.M.D.

N65-19953# Princeton Univ., N. J. Digital Systems Lab.
A REDUCTION TECHNIQUE FOR PRIME IMPLICANT TABLES
James F. Gimpel Aug. 1964 13 p refs
(TR-40; AD-607230)

Solving prime implicant tables is greatly facilitated by reduction techniques such as row dominance, column dominance and essential row selection. This paper presents a new reduction technique which is operable on any otherwise irreducible table having a column covered by two rows. Author

N65-19957*# Emory Univ., Atlanta, Ga.
THE GAMMA FUNCTION WITH VARYING DIFFERENCE INTERVAL
Tomlinson Fort Sep. 1964 16 p refs
(Grant NsG-545)
(NASA-CR-59378) CFSTI: HC $1.00/MF $0.50

A gamma function relationship is established from the solution to the difference equation $\Delta u(x)/h(x) = 1n(x)$, where $x \geq \epsilon > 0$, ϵ is arbitrary, $\Delta u(x) = u(x + h(x)) - u(x)$, and where $h(x)$ is the period of a periodic function of x. Through use of the Euler–Maclaurin sum formula and Bernoulli numbers, the following statement was justified:

$$\left[(x + h(x)) = x^{h(x)} \right]_h (x)$$

Descriptive sections on the general periodic function and on the Euler–Maclaurin sum formula are included. J.M.D.

N65-19985# California Univ., Berkeley. Operations Research Center
GENERALIZED UPPER BOUNDED TECHNIQUES FOR LINEAR PROGRAMMING—I
George B. Dantzig and Richard M. Van Slyke 5 Aug. 1964 24 p ref
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-64-17; AD-610950)

A variant of the simplex method is given for solving linear programs with M + L equations, L of which have the property that each variable has at most one nonzero coefficient. Special cases include transportation problems, programs with upper bounded variables, and assignment and weighted distribution problems. The main feature of the algorithm is that a working basis of order 2M + 1 is utilized for pivoting, pricing, and inversion which for large L can be of significantly lower order than that of the original system. Author

N65-19986# California Univ., Berkeley. Operations Research Center
A FEASIBILITY CONJECTURE RELATED TO THE HIRSCH CONJECTURE

Richard Wollmer 23 Oct. 1964 30 p
(Contract Nonr-222(83); Grant NSF GP-2633)
(ORC-64-28; AD-610951)

The Dantzig conjecture is discussed and used to prove the Hirsch conjecture. Also, the Dantzig conjecture is shown to be false in general. Tables are included which show a counter example, demonstrating that the two conjectures are not equivalent. E.E.B.

N65-19987# California Univ., Berkeley. Operations Research Center
EXPONENTIAL LIFE TEST PROCEDURES WHEN THE DISTRIBUTION HAS MONOTONE FAILURE RATE
Richard E. Barlow and Frank Proschan Oct. 1964 38 p refs
(Contract Nonr-3656(18))
(ORC-64-29; AD-610593)

A number of estimates and tests for mean life and other parameters derived under the exponential distribution assumption are studied under the alternative condition that the distribution has increasing (decreasing) failure rate. The estimates considered are, for the most part, based on censored and truncated samples. It is shown that these estimates generally favor the producer (consumer). Properties of order statistics and their spacings from distributions with increasing (decreasing) failure rate are presented. Author

N65-20114*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio
NUMERICAL INTEGRATION BY GAUSSIAN QUADRATURE
Charles M. Goldstein Washington, NASA, 1965 16 p refs
Presented at 24th Semiannual SHARE Meeting, Los Angeles, 1 Mar. 1965
(NASA-TM-X-52008) CFSTI: HC $1.00/MF $0.50

Simpson's Rule and the Gauss Quadrature formula for approximating integrals are compared. Computer runs were made using Fortran IV subroutines for both methods; the Gauss subroutines are named and their specific functions listed. Comparison of various example integrations under both methods is based on the errors, computing time, and number of evaluation steps. Computing speed for the Gauss method varied between 4.7 and 91 times greater than for Simpson's Rule. It was concluded that Gaussian Quadrature is superior to Simpson's Rule for a wide variety of functions. J.M.D.

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N65-18685# Oslo Univ., Blindern (Norway). Inst. of Theoretical Meteorology
STUDIES IN NUMERICAL WEATHER PREDICTION AND THE DYNAMICS OF FRONTS Final Report
Arnt Eliassen, ed. Aug. 1964 170 p refs
(Contract AF 61(052)-525)
(AFCRL-64-1014; AD-610127)

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3. SOME STABILITY PROPERTIES OF A MATERIAL LAYER MODEL OF THE ATMOSPHERE, PART III Final Report W. Blumen 20 p refs (See N65-18688 09-20)
4. A STUDY OF THE VERTICAL CIRCULATIONS IN A COLD FRONT, PART IV Final Repoi M. Todsen 47 p refs (See N65-18689 09-20)

N65-18686 Oslo Univ., Blindern (Norway). Inst. of Theoretical Meteorology
STUDIES IN NUMERICAL WEATHER PREDICTION, PART I Final Report
Arnt Eliassen, Arne Grammeltvedt, and Ole Bremnes *In its* Studies in Numerical Weather Prediction and the Dyn. of Fronts Aug. 1964 71 p refs (See N65-18685 09-20)

The prognostic equations in primitive form for a mathematical model atmosphere, employing two material surfaces, are given. The equations are written in finite difference form, using the improved Euler–Cauchy method for generalizing ordinary differential equations to partial differential equations. The balance equation is solved to obtain initial winds, by an iteration method which under certain circumstances may not converge. A way of restoring convergence is proposed. Results of 12- and 24-hour predictions for the two-level model are presented for 3 cases—with geostrophic initial winds, with balanced initial winds, and with balanced initial winds and orography. The performance of the model is not bad for the first 12 hours, but deteriorates later, probably because of the development of considerable undulations and slope of the upper material surface. This indicates that a redefinition of the upper surface should be made at least after 12 hours. Author

N65-18688 Oslo Univ., Blindern (Norway). Inst. of Theoretical Meteorology
SOME STABILITY PROPERTIES OF A MATERIAL LAYER MODEL OF THE ATMOSPHERE, PART III Final Report
William Blumen *In its* Studies in Numerical Weather Prediction and the Dyn. of Fronts Aug. 1964 20 p refs (See N65-18685 09-20)

Some baroclinic stability properties of an atmospheric two-layer model, in which the bottom layer is bounded by two constant potential temperature surfaces, are investigated. The perturbation method is employed and the motion takes place on the β-plane. Curves of neutral stability are constructed for three different cases and the results discussed. Author

N65-18689 Oslo Univ., Blindern (Norway). Inst. of Theoretical Meteorology
A STUDY OF THE VERTICAL CIRCULATIONS IN A COLD FRONT, PART IV Final Report
Marius Todsen *In its* Studies in Numerical Weather Prediction and the Dyn. of Fronts Aug. 1964 47 p refs (See N65-18685 09-20)

The transverse circulation in an actual cold front caused by variations in geostrophic wind and temperature along the frontal zone was studied. The study was based partly on a qualitative discussion, but mainly on a numerical solution of the diagnostic differential equation for the stream function of the

nongeostrophic motion in a frontal zone. The effect of condensation on the vertical circulation is considered, as well as that of surface friction. The picture obtained of the total transverse motion shows that both cold and warm air take part in the ascending motion along the front. The vertical velocity profiles were found to have an approximate parabolic form, with a maximum value of ω of about -11 barye sec^{-1} in the case with condensation, and somewhat less in the case without condensation. The estimated value of the amount of precipitation from the velocity profile and the existing vertical temperature distribution agrees fairly well with observed values. Author

N65-18776# Joint Publications Research Service, Washington, D. C.

TRANSLATIONS FROM METEOROLOGIYA I GIDROLOGIYA, NO. 1, 1965

4 Mar. 1965 78 p refs Transl. into ENGLISH from Meteorol. i. Gidrol. (Moscow), no. 1, 1965 p 3–13, 30–45, 53–58, 63–65 (JPRS-28992; TT-65-30441) CFSTI: $3.00

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9. NEWS OF THE ESTABLISHMENTS OF THE HYDROMETEOROLOGICAL SERVICE p 67–68

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11. SOVIET MEETINGS, CONFERENCES AND SEMINARS ON PROBLEMS IN HYDROMETEOROLOGY p 71–74

N65-18777 Joint Publications Research Service, Washington, D. C.

RELATIONSHIP OF SURFACE CYCLOGENESIS INTENSITY TO THE KINETIC ENERGY OF A FLOW AT THE MAXIMUM WIND LEVEL

M. A. Sorochinskiy *In its* Transl. from Meteorol. i Gidrol., No. 1, 1965 4 Mar. 1965 p 1–8 refs (See N65-18776 09-20) CFSTI: $3.00

The kinetic energy of the maximum windflow during cyclogenesis was computed for the period beginning 24 hours before the development of the cyclone and ending with the beginning of its filling. In all considered cases the devevelopment of the cyclone was accompanied by a decrease of kinetic energy with a minimum value at the time of the maximum development of the cyclone (maximum Laplacian of surface pressure with a correlation coefficient of 0.834–0.899). It was found that the intensity of the surface cyclogenesis is dependent on the reserves of kinetic energy in the layer of the maximum wind over a great area. Stronger cyclogeneses develop on the warm side of a jet stream than on the cold side. G.G.

N65-18778 Joint Publications Research Service, Washington, D. C.

SOME CHARACTERISTICS OF CIRCULATION IN THE STRATOSPHERE AND MESOSPHERE

V. P. Dubentsov *In its* Transl. from Meteorol. i Gidrol., No. 1, 1965 4 Mar. 1965 p 9–23 refs (See N65-18776 09-20) CFSTI: $3.00

From rocket observations, factual data were accumulated on temperature and wind in the stratosphere and mesosphere, and used to construct general models of the atmospheric circulation. The presented models of zonal circulation in different latitude zones give only vague principal characteristics of the circulations, because of insufficient data due to the thin network of rocket sounding stations and the low ceilings obtained. Early changes of the zonal circulation in the lower thermosphere seem to indicate that the character of the wind distribution in the mesosphere and stratosphere determines the processes above the mesopause. The stratospheric circulation is dependent on the ozone content and distribution. G.G.

N65-18779 Joint Publications Research Service, Washington, D. C.

ESTIMATING THUNDERSTORM ACTIVITY FROM RADIO BEARING DATA ON ATMOSPHERICS

V. A. Solov'yev *In its* Transl. from Meteorol. i Gidrol., No. 1, 1965 4 Mar. 1965 p 24–33 refs (See N65-18776 09-20) CFSTI: $3.00

Radio direction-finding data on electromagnetic pulses that develop during thunderstorm discharge were combined with meteorological observations and used to determine the location and intensity of thunderstorm activities for European territory and its adjacent seas, and for the Far Eastern network. Maps on the distribution and frequency of thunderstorm centers were compiled and are graphically presented. Data from radio direction findings of atmospherics and from meteorological stations on the number of thunderstorm centers for the European territory of the U.S.S.R. had a correlation coefficient of 0.91. The average annual thunderstorm activity for the European territory and its seas and the Far Eastern network was greater on the land than on the ocean, and diurnal and seasonal distributions differed widely. It was concluded that the use of lightning stroke data makes it possible to characterize thunderstorm activities for remote marine and continental regions that contain few meteorological networks. G.G.

N65-18780 Joint Publications Research Service, Washington, D. C.

ON AN ERROR IN CALCULATION OF THE LONG-WAVE RADIATION BALANCE

T. V. Kirillova and S. P. Malevskiy-Malevich *In its* Transl. from Meteorol. i Gidrol., No. 1, 1965 4 Mar. 1965 p 34–38 refs (See N65-18776 09-20) CFSTI: $3.00

Proof is presented that modifications of the basic equation for the balance of long-wave radiation in the form

$$B_{long} = E_a - \delta E_{bl} - (1-\delta)E_a$$

by assuming values for the flux of natural radiation of the surface δE_{bl} that differ from unity. The ascending flux of

long-wave radiation cannot be identified with the flux of thermal radiation of the surface without taking into account the reflected part of atmospheric backscatter. Examples of computation errors in the case of $\delta = 1$, and in the case of incorrect writing of the balance equation as

$$B_{long} = E_a - \delta E_{bl}$$

are given. The identification of the flux of thermal radiation of the surface with the ascending flux by a factor of 2 to 5 increases errors even in comparison with the assumption that the surface is a true blackbody. G.G.

N65-18781 Joint Publications Research Service, Washington, D. C.
SOME DATA ON EXPERIMENTS IN INTENSIFICATION OF WINTER PRECIPITATION
M. P. Leonov *In its* Transl. from Meteor. i Gidrol., No. 1, 1965 4 Mar. 1965 p 39–43 (See N65-18776 09-20) CFSTI: $3.00

Seeding experiments to intensify precipitation of supercooled liquid-drop clouds along their vertical surfaces, and of mixed structure clouds along the upper boundaries of the liquid-drop part are reported. Results obtained during the four winter seasons indicate a vertical thickness of supercooled liquid-drop layers greater than 250 to 300 m at temperatures above −4° C as the most favorable meteorological conditions for successful modification of the precipitation effects. Additional precipitation ranged from a low of between 35 and 50 tons to a high of between 1100 and 1400 tons in individual seeding experiments, and the total effect for the experimental meteorological polygon increased the normal November to February precipitation by 10% to 15%. It was assumed that precipitation intensification leads to an increase rather than to a redistribution of precipitation through the acceleration of the moisture cycle. G.G.

N65-18782 Joint Publications Research Service, Washington, D. C.
THE 300-METER METEOROLOGICAL TOWER AND ITS COMPLEX OF APPARATUS AS A METHOD OF INVESTIGATING THE LOWER ATMOSPHERE
F. Ya. Klinov *In its* Transl. from Meteorol. i Gidrol., No. 1, 1965 4 Mar. 1965 p 44–54 refs (See N65-18776 09-20) CFSTI: $3.00

A 310-m-high meteorological observation tower is described that contains a working point at the top and 13 additional working levels at different heights. Instrumentation determines the meteorological parameters of the lower atmosphere, and computes formulas for the following applied problems: air temperature and its vertical gradient, velocity and direction of airflow, air humidity, and radiation characteristics. The recording of the measurements and the control of the measurement systems are centralized; automation of the recording of the measurements includes simultaneous feeding of information to the punching mechanism. This system allows the collection of passive meteorological data on changes of the parameters and derivatives of meteorological characteristics, with subsequent analysis of the measurement data for various purposes, such as planned forecasts. G.G.

N65-18783 Joint Publications Research Service, Washington, D. C.
LITERATURE ON METEOROLOGY AND HYDROLOGY FOR 1964
In its Transl. from Meteorol. i Gidrol., No. 1, 1965 4 Mar. 1965 p 55–64 refs (See N65-18776 09-20) CFSTI: $3.00

This bibliography from the Russian journal *Meteorology and Hydrology* contains lists of the hydrometeorological literature published during 1964. Problems of interest to the workers in the hydrometeorological service, and information on the transactions of scientific research institutes working in this field are included. G.G.

N65-18835* National Aeronautics and Space Administration, Washington, D. C.
LIGHT DETECTOR FOR SOUND BOMB
Iwaho Yoshiyama, Sigeo Imazawa, and Takemi Wanami *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 250–253 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Measuring the wind and temperature of the atmosphere by the sound bomb method requires high accuracy in measuring the time period of illumination. Phototransistors were installed in the body of the K-8-7 type space rocket and the illumination time period detected was sent by the teletransmitter. Results showed the two pulses from the lights of the firing and explosion were detected separately without interference or masking. All sound bombs were exploded and detected. R.W.H.

N65-18880# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NF 3.162 (S/N NRL 105-3) (30 JANUARY 1965), Meteorological Data Report
Marjorie Mc Lardie Hoidale Feb. 1965 28 p
(ERDA-268)

Meteorological data gathered for the launching of Aerobee NF 3.162 (S/N NRL 105-3) are presented for ballistic studies. Calculated ballistic data are also presented. Author

N65-18978# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group
HEAT TRANSPORT BY LARGE-SCALE ATMOSPHERIC WAVES DURING OCTOBER 1959–MARCH 1960 Scientific Report No. 10
Calvin E. Anderson Sep. 1964 61 p refs *Its* Publ. in Meteorol. No. 69
(Contract AF 19(604)-8431)
(AFCRL-64-856; AD-609803)

A spectral analysis of northward heat transport in the Northern Hemisphere was performed by the Fourier analysis method. This method was applied at 500, 100, and 25 mbars for 5-day intervals from October 5, 1959 through March 28, 1960. A comparison of stratospheric warmings of this period with those of the previous year revealed that the heat transport could be accomplished mainly by wave numbers one and/or two. From 500-, 100-, and 25-mbar time-sections of northward heat transport, divergences were determined to calculate the local temperature time derivatives. These derivatives were in turn compared with the actual time-sections of mean temperature. This comparison showed that, due to strong convergence of northward heat transport, the winter stratosphere at high latitudes had a net ascending motion. Author

N65-18979# Chicago Univ., Ill. Dept. of the Geophysical Sciences
A STUDY OF CUMULUS CLOUDS OVER THE FLAGSTAFF RESEARCH NETWORK WITH THE USE OF U-2 PHOTOGRAPHS Scientific Report No. 3

Dorothy L. Bradbury and Tetsuya Fujita Jul. 1964 30 p refs *Its* SMRP Res. Paper No. 33
(Contract AF 19(604)-7259; Grant NSF G-18984)
(AFCRL-64-895; AD-610019)

Using cloud photographs taken by a U-2 aircraft equipped with a 180-deg panoramic camera, a technique of rectification is described. Mosaics of 13 passes over the San Francisco Mountains were made with the rectified cloud photographs. Computations of cloud movement and change in the horizontal area of cloud were made by use of cloud and cloud shadow. It was found that the computed cloud motions are within the range of the wind speeds reported from nearby upper air reporting stations. Author

N65-18982# Texas A&M Univ., College Station. Dept. of Oceanography and Meteorology
A WET- AND DRY-BULB TEMPERATURE MEASURING SYSTEM FOR MICROMETEOROLOGICAL APPLICATION Final Report
William H. Clayton, B. Jesse Eckelkamp, and Joe H. Machetta Sep. 1964 61 p refs
(Contract AF 19(628)-2411)
(AFCRL-64-938; AD-610107)

This report reviews the construction of a wet- and dry-bulb temperature measuring system based on a prototype developed for use on Project Green Glow. Condensed descriptive and schematic representations of the developed system in the engineering as well as the meteorological sense are included. Field testing procedures are thoroughly described, and test data are summarized. The system will provide wet-bulb depression to within 0.25° C, in digital form, at 5-sec intervals for depression magnitudes in excess of 15° C. For lower depression rates the resolution is less than 0.1° C at the 5-sec sampling rate. Resolution for averaged intervals of the order of 5-min or greater is within 0.05° C for depression magnitudes below 15° C, excepting saturation conditions for which no evaluation can be given inasmuch as such conditions were not met at the field testing site. Author

N65-19100# Air Force Cambridge Research Labs., Bedford, Mass.
WINTER SPACE CORRELATIONS OF PRESSURE, TEMPERATURE, AND DENSITY TO 16 km
Eugene A. Bertoni and Iver A. Lund Dec. 1964 85 p refs *Its* Environ. Res. Papers No. 75
(AFCRL-64-1020; AD-611002)

The winter vertical and horizontal correlations between pressure, temperature, and density at fixed geopotential heights (to 16 km) are presented for 27 observation stations in the Atlantic Ocean and Europe. Many figures are shown to depict the decay of correlation both in the horizontal and in the vertical direction. A small effort directed toward improving the simple Markov decay function met with little success. Author

N65-19122# Stanford Research Inst., Menlo Park, Calif.
CLEAR-AIR TURBULENCE AND ITS ANALYSIS BY USE OF RAWINSONDE DATA Final Report
R. M. Endlich and R. L. Mancuso Jun. 1964 63 p refs
(Contract Cwb-10624)
(AD-603570)

This investigation includes (1) a review of selected aspects of turbulence, emphasizing the large size and persistent nature of certain areas of moderate or severe turbulence; (2) a study of turbulence in pronounced jet stream flow over mountains; and (3) the definition of a turbulence index (TI) on empirical grounds as the product of wind speed, turning of the wind with height, and change of lapse rate. In order to test the utility of standard upper air data in turbulence analysis, values of Richardson's number and TI were determined by electronic computer in eight layers between 500 and 150 mbars at all rawinsonde stations in the United States during the period 12–24 March 1962. These values are compared with turbulence reports made by pilots of jet aircraft; several maps are presented that illustrate the substantial agreement. Standard statistical tests show that both numbers have definite skill in turbulence analysis. Author

N65-19127# McGill Univ., Montreal (Quebec). Arctic Meteorology Research Group
THE INVERSION OVER THE POLAR OCEAN Scientific Report No. 14
E. Vowinckel Jan. 1965 41 p refs *Its* Publ. in Meteorology No. 72
(Contract AF 19(604)-7415)
(AFCRL-65-26; AD-610669)

Radiosonde ascent data were used in the investigation. The data available from the Polar Ocean proper were insufficient to permit a regional investigation. The results refer to the Polar Ocean as a whole, with special weight on the central parts. No month shows less than 59% of the time with an inversion present, and in late winter there is a constant inversion over the Polar Ocean. The surface inversion has a long mean duration in winter–spring, and a normal duration in summer. A slightly stable stratification is found over the Polar Ocean in summer. Conditions change drastically towards winter. Very unstable gradients predominate over the warm waters of the Norwegian–Barents Sea, and a sharp gradient is seen on the maps towards the Polar Ocean, where very strong inversions predominate. The strongest positive vertical temperature gradient (the most intense inversion) is found over the Beaufort Sea and NW of the Canadian Archipelago. The most frequent occurrence of inversion is found towards the Siberian side of the Polar Ocean. Author

N65-19164# Army Electronics Labs., Fort Monmouth, N. J. Meteorological Div.
THE CYLINDRICAL FIELD MILL
Heinz W. Kasemir Oct. 1964 21 p refs
(ECOM-2526; AD-610485)

A field-mill-type instrument is described which is especially suited to recording the atmospheric electric field from an airplane. The instrument measures the two components of the electric field vertical to its axis and rejects the component in the direction of the axis. This feature can be used to eliminate the influence of the airplane charge on the measurement of the atmospheric electric field so that also weak fields down to the order of 2 volts per meter can be recorded. Furthermore, each cylindrical field mill delivers two components of the electric field so that only two field mills of the cylindrical type are required to obtain all three components of the atmospheric electric field. Author

N65-19219# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
PROPERTIES OF SNOW
Malcolm Mellor Dec. 1964 114 p refs *Its* Cold Regions Sci. and Eng., Pt. III, Sect. A
(AD-611023)

Formation, composition, mechanical characteristics, elastic behavior and ultimate strength under rapid loading, creep under sustained loading, surface friction and adhesion, thermal properties and radiation characteristics, and electrical properties of snow are summarized. E.E.B.

N65-19378# Litton Systems, Inc., Minneapolis, Minn. Applied Science Div.
ARCTIC STRATOSPHERIC TEMPERATURES AND DENSITIES Final Report
L. W. Engberg and A. D. Belmont 21 Aug. 1964 216 p refs *Its* Rept. No.-2602
(Contract AF 19(628)-383)
(AFCRL-64-806; AD-610603)

Frequency distributions of temperature and density, their means and standard deviations were computed for two different definitions of season at specified height and pressure levels to 30 km and 10 mb for six Arctic stations using 1956–1960 data. A limited number of interlevel correlations were also computed for one definition of season at constant heights only. Differing seasonal definitions gave large differences in distribution characteristics. Distributions of temperature at corresponding pressure and height levels for identical season definitions were examined for significant differences, but none were found. Sudden warmings were observed at all stations, but only one showed a bimodal temperature distribution for five years of combined data. Using shorter data periods, other stations also exhibited the bimodal form. Author

N65-19447 Israel Program for Scientific Translations, Ltd., Jerusalem.
ATMOSPHERIC PROCESSES IN THE HIGH LATITUDES OF THE SOUTHERN HEMISPHERE Section II of IGY Program, No. 3
P.D. Astapenko 1964 294 p refs Transl. into ENGLISH of "Atmosfernye Protsessy v Vysokikh Shirotakh Yuzhnogo Polushariya" Moscow, Izd. Akad. Nauk SSSR, 1960 Publ. for Dept. of Com. and NSF
(OTS-63-11142; IPST-891)

Observations of the atmospheric circulation in the high latitudes of the Southern Hemisphere with emphasis on the Antarctic and its surroundings were carried out through collection and preliminary processing of the observational data; identification of the recorded weather phenomena and their order of succession; determination of the regime of the meteorological elements and synoptic processes controlling them; comparison of the actual weather pattern with former observations; and preliminary conclusions and evaluations of the investigated problem. Part of the data is presented on mean monthly charts, in a journal of synoptic processes, and in various tables. The aspects of forecasting in the Antarctic complex are discussed. G.G.

N65-19454# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
INACCURACIES OF THE SINGLE-THEODOLITE WIND MEASURING SYSTEM IN BALLISTIC APPLICATION
H. M. Richart Feb. 1965 24 p refs
(ERDA-272; AD-458309)

Errors in the single-theodolite pilot-balloon observational system are examined, and effects of these errors on the impact displacements of unguided missiles are presented. A method is shown which permits use of the single-theodolite system during periods of light winds in support of missile systems having high exit velocities, low unit wind effect, and low impact dispersion. Author

N65-19478# Freie Univ., Berlin (West Germany). Inst. für Meteorologie und Geophysik
DAILY AND MONTHLY NORTHERN HEMISPHERE 30-MILLIBAR SYNOPTIC WEATHER MAPS OF THE YEAR 1964, PART III Quarterly Technical Status Report
Barbara Kriester, Richard Scherhag, and Renate Stuhrmann Dietrich Reimer, 1965 104 p refs *Its* Meteorol. Abhandl., Vol. 48, No. 3
(Contract DA-91-591-EUC-3288)
(QTSR-3) Available from Deitrich Reimer: 15 DM

Stratospheric circulation during July, August, and September, 1964, is discussed; mean monthly maps, as well as daily 30-millibar synoptic weather maps, are presented for this period. M.P.G.

N65-19648# Kitt Peak National Observatory, Tucson, Ariz.
[FACILITIES AND EQUIPMENT FOR ASTRONOMY, PLANETARY AND SPACE SCIENCES] Monthly Report
1964 33 p refs Sponsored by NSF

Observations and calibration experiments on three telescopes are summarized, as well as progress in Aerobee rocket sounding programs and theoretical consideration of planetary atmospheric compositions from CO_2 absorption data. E.P.V.

N65-19556# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex.
AN IMPROVED METHOD FOR THE REDUCTION OF ROCKETSONDE TEMPERATURE DATA
John G. Mc Coy Mar. 1965 13 p ref
(ERDA-279; AD-458318)

A method is described for the reduction of temperature data which are obtained through the use of a rocketsonde with a bead thermistor serving as the temperature sensor. The method is designed to improve the accuracy and reliability of the reduced vertical temperature profiles between the altitudes of 40 and 65 km when the temperature of the thermistor, due to sensor response time and fall rate, is not in temperature equilibrium with the surrounding atmosphere. The technique is applicable to rocketsondes equipped with cylindrical brass posts or the more recently proposed thin-film as the supports for the bead thermistor. Author

N65-19584# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE NB 3.161 (S/N NRL 101-3) (25 NOVEMBER 1964) Meteorological Data Report
Marjorie Mc Lardie Hoidale and Ivan I. Layton Dec. 1964 34 p
(ERDA-239; AD-458311)

Meteorological data gathered for the launching of Aerobee NB 3.161 (S/N NRL 101-3) are presented. Author

N65-19585# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
ATHENA FLIGHT NO. 011, VEHICLE D-002 (12 FEBRUARY 1965) Meteorological Data Report
Len E. Carter and John M. Sharpe Mar. 1965 66 p refs
(ERDA-282; AD-458319)

Meteorological data gathered for the launching of Athena Flight Number 011, Vehicle D-002, are presented in tabular form. Author

N65-19671# American Meteorological Society, Boston, Mass.
A MECHANISM OF AEROSOL PARTICLE CAPTURE BY A DROPLET IN A CONDENSATION OR EVAPORATION PROCESS [SUR UN MECANISME DE CAPTURE DES PARTICULES D'AEROSOLS PAR UNE GOUTTELETTE EN VOIE DE CONDENSATION-EVAPORATION]

Leopold Facy Bedford, Mass., AFCRL, Aug. 1964 8 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 246, no. 22, 1958 p 3161–3164
(Contract AF 19(628)-3880)
(T-F-65; AD-452875)

The motion of aerosols was studied in a system of evaporation and condensation using an isolated droplet in an infinite ambient tobacco smoke or magnesia medium of known vapor pressure contained in a copper test cell. During the evaporation process, a dust-free clear space occurred that surrounded the evaporating droplet after the introduction of the tobacco smoke aerosol, and had a diameter proportional to the decrease of aerosol particle count resulting from processes of coagulation and precipitation on the walls. In a system of complete diffusion, the tobacco smoke was arrested away from the center of the droplet owing to forces exerted by osmotic pressure and the vapor pressure gradient. Expressions are established for determining the criteria influencing the occurrence of clear space. During condensation, a continuous afflux of aerosol particles impacted on the droplet, clung to its surface and disappeared in its interior after the saturation of magnesia. Osmotic pressure, gravitational force and vapor pressure prevented thermal repulsion of the aerosol particles by temperature gradients. Thermal gradients and their moderation by radiative diffusivity are discussed. S.C.W.

N65-19815# Brown Univ., Providence, R. I.
EXTENSIONS TO THEORY OF TIME SERIES ANALYSIS Quarterly Report, 1 May–31 Jul. 1964
Walter Freiberger [1964] 10 p ref
(Contract DA-36-039-SC-87222)
(QR-8; AD-606187)

A second-order differential equation in r(P,P') is presented; P and P' are two arbitrary points in a two-dimensional meteorological field, and r(P,P') is the covariance between the temperatures over time for those points. The basic conditions for the derivation are that the temperature at any point (x,y) be a random variable with respect to time, and that the curves for equal covariance (isopleths) be ellipsoids centered at the origin (0,0). J.M.D.

N65-19823# Institut Royal Meteorologique de Belgique, Brussels.
PRECIPITATION STATISTICS FOR BRUSSELS-UCCLE [LA STATISTIQUE DES PRECIPITATIONS A BRUXELLES-UCCLE]
R. Sneyers 1964 26 p refs Repr. from "Ciel et Terre", no. 5–6, May–Jun. 1964 Presented at the Conf. of the Natl. Belg. Comm. of Geodesy and Geophys., 19 Mar. 1964 *Its* Contributions No. 94

Rainfall measurements made at Brussels from 1833 to 1889 and at Uccle since 1890 are analyzed to establish the homogeneity of the only long series of rainfall observations available in Belgium. Also given is the statistical theory that was developed for the rainfall analysis and its application each time to compare series of measurements made with different instruments. M.P.G.

N65-19869*# Stanford Research Inst., Menlo Park, Calif.
MEASUREMENT OF FORWARD-SCATTER CROSS SECTIONS IN THE MELTING LAYER
F. G. Fernald and A. S. Dennis [1964] 4 p refs
(Contract NASr-49(02))
(NASA-CR-57468) CFSTI: HC $1.00/MF $0.50

Simultaneously obtained data of forward-scatter and back-scatter cross sections in the melting layer of snowflakes were gained by C-band weather radar observation over a period of 7 weeks. Analyses confirmed the expectation that the mean forward-scatter cross section per unit volume of the melting layer exceeds the back-scatter cross section per unit volume at the middle of the common volume in the bright band at centimeter wavelengths. G.G.

N65-19940# Institut Royal Meteorologique de Belgique, Brussels.
CONVERSIONS WITHOUT THERMAL AND ENERGY EXCHANGE IN THE ATMOSPHERE [LES TRANSFORMATIONS SANS ECHANGE THERMIQUE ET SANS ECHANGE ENERGETIQUE DANS L'ATMOSPHERE]
L. Dufour 1964 82 p refs In FRENCH *Its* Publ. Ser. B, No. 44

Definitions and equations for adiabatic and pseudoadiabatic changes in the atmosphere are deduced logically from the principles of thermodynamics. In each case, the general formula and the simplifying hypotheses are given as directly as possible to permit meteorologists to study particular changes with a minimum of calculation. Among the cases considered are open systems, closed systems, open systems separated by a surface of discontinuity, humid air with and without the condensed water phase, humid air containing two condensed water phases, and vertical movements in the atmosphere. M.P.G.

N65-20000# Army Electronics Research and Development Activity, White Sands Missile Range, N. Mex. Meteorological Support Div.
AEROBEE AD 3.516 (S/N AF 148) (2 MARCH 1965) Meteorological Data Report
Marjorie Mc Lardie Hoidale Mar. 1965 43 p refs
(ERDA-290; AD-458903)

Meteorological data gathered for the launching of Aerobee AD 3.516 (S/N AF 148) are presented. The data appear in the appendixes along with calculated ballistic data. Author

N65-20012# Dayton Univ., Ohio. Research Inst.
ERROR ANALYSIS AND COMPUTATIONS OF WIND SPEED AND WIND DIRECTION FROM AIRCRAFT DOPPLER DATA Scientific Report No. 1
Marie Durling, Nicholas Engler, and Donald Kahle Bedford, Mass., AFCRL, Aug. 1964 64 p refs
(Contract AF 19(628)-2402)
(AFCRL-64-703; AD-612023)

The use of a piloted aircraft to determine the magnitude and direction of the wind speed vector involves the direct measurement and recording of several basic parameters, such as ground speed, drift angle, and air speed, from which the wind speed vector is computed trigonometrically. This paper describes the significant mathematical relationships among these basic parameters, their errors, and the resultant errors in wind speed and wind direction. After development of the general error equations, examples are given using Aircraft APN 102 doppler data from typical flights made by a high-altitude reconnaissance aircraft. Author

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N65-18648# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFRARED SELF-GUIDANCE OF MISSILES
T. Burakowski and A. Sala 23 Nov. 1964 22 p refs Transl. into ENGLISH from Wojskowy Przeglad Lotniczy (Warsaw), v. 17, no. 5, 1963 p 22–36
(FTD-TT-64-85/1+2; AD-453063)

Principles underlying the importance and development of infrared-sensitive devices for locating and direction-finding of radiating aircraft are reviewed. The nature of infrared self-guidance is discussed, and the basic arrangements of infrared self-guidance systems are described. A discussion of flight trajectories of self-guidance missiles includes the normal "pursuit" trajectory and the straight intercept type of trajectory with constant angle between target and missile flight direction. The problem of construction of infrared self-guidance sensors is treated at length, and the use of this principle of missile guidance is traced chronologically from the German Schmetterling missile in World War II through the American missiles Red Eye and Sidewinder. Various present or potential applications of infrared self-guidance are discussed briefly. D.E.W.

N65-18896# Joint Publications Research Service, Washington, D. C.
STUDIES IN NAVIGATION SYSTEMS AND EQUIPMENT
V. Kozyar and N. Kubachev 10 Mar. 1965 12 p Transl. into ENGLISH from Morsk. Flot (Moscow), no. 1, Jan. 1965 p 18–19, 23 (JPRS-29068; TT-65-30485) CFSTI: $1.00

Loran receivers and a remote reading magnetic compass, as used in marine navigation, provide a great savings and reduce the number of accidents on the sea. A Loran receiver uses a cathode ray tube indicator for measuring the time intervals between moments of arrival of impulses. It receives wide distribution because of high quality and ease of servicing. More than 60 Loran stations are operating throughout the world, providing long-range navigation over most of the northern parts of the Pacific and Atlantic Oceans, shores, and straits. The remote reading magnetic compass has the advantage of no turning elements of the automatic control system within the compass bow; when the remote transmission goes out of operation it can be used as a normal course indicator. If a remote reading compass is installed, a reserve magnetic box of a special type should be included as emergency equipment. R.W.H.

N65-18907# Bendix Corp., North Hollywood, Calif. Bendix-Pacific Div.
HELICOPTER RADAR NAVIGATION SYSTEM AND ENHANCEMENT DEVICES Final Report, Mar.–Sep. 1964
M. L. Palmquist Sep. 1964 87 p refs
(Contract FAA-ARDS-510)
(RD-64-125)

This program was initiated by the Federal Aviation Agency to provide a navigational radar system to be used in evaluating radar as a prime navigation aid for helicopter operations. The radar system developed for this program operates in the 15.4- to 15.7-Gc navigation band, and uses a slotted array antenna to form an approximate cosecant-squared pattern. The direct-view storage display unit provides a bright PPI display, with range representations of 1.5, 5.0, and 15.0 miles. Information renewal rotation speed is 30 rpm; pulse length is 0.22 microseconds and beam width is 2°. Selection of video types is incorporated to enable evaluation of the FTC, video processor, and displaying beacons. The scope of the program was expanded to include three compatible ground-based beacons, and three passive enhancement devices. Author

N65-18908# Stanford Research Inst., Menlo Park, Calif. Aerophysics Lab.
A STUDY OF THE SENSITIVITY OF A SUPERSONIC AIRCRAFT TO THE EFFECT OF VARIOUS HORIZONTAL TEMPERATURE DISTRIBUTIONS Final Report
Sidney M. Serebreny Oct. 1964 41 p refs
(Contract FAA/BRD-420)
(RD-64-111)

The effect of the variations in the horizontal distribution of temperature on supersonic transport operation in cruise was studied on the New York–London–Paris route. From the data sample the range of temperature variations was established. Temperature variations in 24 cases were run through a computer program and fuel consumption was derived. The results of this program closely approximated the theoretical temperature fuel consumption. In none of the cases did the temperature gradient warrant diversion from great circle. The cases chosen reflected extremes of departure from standard, and present a seasonal distribution of such variations. Average route temperature differences from 141 selected dates substantiate the predominant lack of adequate gradients for such track diversions from great circle. Author

N65-19047# Federal Aviation Agency, Atlantic City, N. J. Experimentation Div.
INVESTIGATION OF HIGH ALTITUDE REPORTING WITH AIR TRAFFIC CONTROL RADAR BEACON SYSTEM
George H. Mahnken and Felix Hierbaum Jan. 1965 19 p
(RD-65-2)

This document covers the high-altitude phase of the test program on altitude transmission equipment. Technical data and Air Traffic Control (ATC) operations analysis were obtained from the regularly scheduled flights of a plane instrumented with this equipment. Operational feasibility was demonstrated whereby live altitude reporting from an equipped commercial airliner operating within the normal ATC environment was automatically available to the ground. Author

N65-19049# Federal Aviation Agency, Washington, D. C. ATC Development Div.
SCHEDULED AIR CARRIER FLIGHT ACTIVITY IN THE UNITED STATES, NOVEMBER 1964 Interim Report
Ellen S. Reynolds Feb. 1965 17 p
(RD-65-16)

This report describes flight activity scheduled by commercial air carriers in the United States during November 1964. It was prepared from an IBM tape containing records of all flights listed in the November 1–15, 1964 issue of the Official Airline Guide. Flight activity is described in terms of airline, aircraft type, day of week, hour of day, and patterns of flow. Author

N65-19050# Cutler-Hammer, Inc., Deer Park, N. Y. Airborne Instruments Lab.
USE OF SELF-CONTAINED NAVIGATION AIDS IN DOMESTIC AIRSPACE Final Report
E. N. Hooton, I. S. Wisepart, and P. Abramson Sep. 1964 128 p refs
(Contract FA-WA-4680)
(AIL-3523-1; RD-64-131)

This report contains an introduction to general navigational principles as applied to the use of Doppler and inertial systems, followed by a description of both systems concerning methods of operation, accuracy, etc. Checking inflight errors by some external ground-based navigation aids is discussed; simplified procedure is given using VORTAC. After a description of airline flight planning, the impact of self-contained

navigation techniques on the air-traffic-control system is discussed relative to en route flying and the terminal area. It is concluded that Doppler and inertial can be used successfully in domestic operations and that, subject to certain procedures, every encouragement should be given to all operators (including general aviation) to use Doppler, and later inertial, in the domestic airspace. Author

N65-19682# Collins Radio Co., Cedar Rapids, Iowa.
COMPUTER/SIMULATION STUDY OF AIR-DERIVED SEPARATION ASSURANCE SYSTEMS IN MULTIPLE AIRCRAFT ENVIRONMENT First Interim Report
R. D. Joy, D. E. Killham, and L. K. Belden Oct. 1964 245 p refs
(Contract FA-WA-4598)
(FAA-RD-64-138)

This report describes (1) analytical studies of three types of air-derived separation assurance (ADSA) techniques, (2) specifications of simulated aircraft environments to be recorded by the National Aviation Facilities Experimental Center, and (3) a computer program which simulates the performance of ADSA techniques under lifelike conditions. Measurement errors in the synchronized airborne oscillator (SAO) range-altitude (R-A) system caused less degradation of performance than those of the ground-bounce R-A and the interrogator-transponder relative position-velocity (RP-V) systems. Medium quality crystal oscillators can be used in the SAO. The tau criterion offers complete protection in unaccelerated flight. In turning flight, the normal velocity criterion of the RP-V system is unsatisfactory and should be eliminated. Of the three systems, the SAO resulted in less critical situations in turns, but still did not offer adequate protection. A quantity called projected tau can be used to evaluate hazards in maneuvering flight by utilizing relative bearing and aircraft heading to project around the curved path. Author

N65-19983# Naval Research Lab., Washington, D. C. Applications Research Div.
THE RAINBOW OPTICAL LANDING AID
Barbour Lee Perry 1 Feb. 1965 20 p refs
(NRL-6184; AD-611570)

The Rainbow Optical Landing Aid is an optical–geometrical system which requires no mechanical or electronic sensing of flight parameters. In preliminary tests it has been used in bright sunlight at ranges as great as 3 1/2 miles. A high level of accuracy is achieved in using the Rainbow Optical Landing Aid because of three outstanding features: (1) It has display sensitivity independent of range. The system is sensitive to small errors even at long ranges, providing the pilot with a positive indication of error at any conceivable range at which he might wish to turn "final." (2) It also has provision of a quickening term. The error indication tells the pilot how to modify sink rate rather than altitude. (3) Finally, it has sensitivity of display to angular rate inversely proportional to error from glide path. The use of quickening makes feasible a nonlinear sensitivity between displayed error and actual error. The sensitivity becomes very high near glide path, contributing materially to the precision control of altitude. Author

N65-19984# Naval Research Lab., Washington, D. C. Applications Research Div.
DESIGN EQUATIONS FOR RAINBOW OPTICAL LANDING AID
Carol A. Roberts 5 Feb. 1965 18 p ref
(NRL-6199; AD-611571) CFSTI: $0.50

The Rainbow Optical Landing Aid is a carrier-based landing display system which enables the pilot to control the rate of descent of his aircraft to a high level of accuracy. The system is purely optical–geometrical and requires no electronics. The command signal is presented as a color-coded array of lights, achieved by mounting color transparencies of exponential curves on a revolving transparent drum and projecting the resultant pattern into space. This report is concerned with the color pattern on the revolving drum of the Rainbow optical landing display, including both the basic mathematical aspects of this pattern and its color coding. Author

N65-20090# Saab Aircraft Co., Linkoping (Sweden).
EYE LEVEL FLIGHT INFORMATION BY A PERSPECTIVE POLE-TRACK
Lennart Nordström Jan. 1965 16 p
(SAAB-TN-58)

Principles and applications of an integrated display of flight information are described. The flight situation in relation to a desired flight path and in relation to the ground is represented by a perspective pole-track. The easily interpreted symbol configuration provides an immediate overall picture of the flight situation with facilities for both qualitative and quantitative readings. Applications for low-altitude flight—e.g., landing—are of special interest as the display method makes it possible to integrate in a natural way the important information about height. The principles have been developed primarily for a head-up display but are also suitable for a head-down electronic display, on which integration can be arranged with other flight-attitude information. Flight director principles can be applied, if desired. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N65-18919*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
INVESTIGATIONS OF CARBIDES AS CATHODES FOR THERMIONIC SPACE REACTORS Informal Monthly Report, Mar. 1963
L. Yang, A. F. Weinberg, F. D. Carpenter, M. H. Horner, R. G. Hudson et al 29 Apr. 1963 24 p refs
(Contract NAS3-2532; Proj. 306)
(NASA-CR-57167; GACD-4210) CFSTI: HC $1.00/MF $0.50

N65-18951# Union Carbide Corp., Oak Ridge, Tenn. Nuclear Div.
MINIMUM CRITICAL CYLINDER DIAMETERS OF HYDROGEN MODERATED U(4.9) SYSTEMS
C. E. Newlon 15 Mar. 1965 14 p refs
(Contract W-7405-ENG-26)
(K-1629) CFSTI: $1.00

From a review of recent experimental data for a homogeneous, hydrogen moderated and reflected $U(4.9)O_2F_2$ system, and correlation with 16-group transport theory calculation, it appears that the minimum critical, infinite length cylinder diameter is 12.1 inches for the hydrogen moderated and reflected UF_6 system. The maximum uranium density of the UF_6

is taken as 3.2 g. U/cc. Calculations indicate that the use of a 0.20-inch wall thickness stainless steel or nickel container may increase the assigned minimum critical cylinder diameter about 0.9 inch. Author

N65-18988# Air Force Systems Command, Edwards AFB, Calif. Air Force Rocket Propulsion Lab.
APPLICATIONS OF RADIOISOTOPE LIQUID LEVEL GAGES AT THE AIR FORCE ROCKET PROPULSION LABORATORY
Robert P. Couch Jul. 1964 37 p
(RPL-TDR-64-123; AD-609836)

Extensive testing and application to test stand operations proved the radioisotope liquid level gage to be a versatile, inexpensive, and accurate method of point level gaging. The nuclear system proved accurate to $\pm 1/16$ inch under simulated boiling cryogenic conditions, and is recommended as a universal liquid level gage for all future liquid rockets which require accurate point level sensors. Author

N65-18998# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
NUCLEAR TECHNOLOGY BRANCHES QUARTERLY REPORT, APRIL 1–JUNE 30, 1964
D. R. de Boisblanc, W. C. Francis, M. E. Thomas, R. G. Fluharty, and L. A. Schmittroth Nov. 1964 83 p refs
(Contract AT(10-1)-205)
(IDO-17042) CFSTI: $3.00

Research studies reported are (1) reactor engineering—reactor fuels and materials development, and critical facilities; (2) nuclear technology—cross sections program, nuclear chemistry, inelastic scattering, reactor experiments, theoretical physics, and low-energy nuclear physics decay scheme studies; (3) instrument development—detector development, instrumentation analysis, and instrument component and systems development; and (4) mathematical analysis and machine computations—contour plot subroutine (CONPLT), inventory control program, shifty gamma fitter, reactor codes development, Spert IV stability study, data error return, combination cross section convolution program (COMBCO), multilevel cross sections convolution program (MLCNVL), and burst fitting program (BURFIT). R.W.H.

N65-19040# Atomics International, Canoga Park, Calif.
DEVELOPMENT, FABRICATION AND TESTING OF HONEYCOMB RADIATOR CONDENSER
G. Scott and W. Engle 1 Mar. 1965 51 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9885) CFSTI: $3.00

The development, fabrication, and testing of the mercury rankine (SNAP 2) prototype design steel-honeycomb radiator–condenser are summarized. The discussion includes a description of the basic design, the principle elements of this design, the development required to produce the full-size units, and the test program conducted with both radiator–condenser components and assemblies. Author

N65-19041# Atomics International, Canoga Park, Calif.
DEVELOPMENT OF HIGH-TEMPERATURE ELECTRICAL GROUND TEST HEATERS FOR THE SNAP 10A PROGRAM
R. Blevitt, G. Paine, and S. Sudar 1 Mar. 1965 135 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-9894) CFSTI $2.50

The heater development program for acceptance-test heaters and reactor-simulator heaters is described. Two types of acceptance-test heaters were developed: a conduction type permanently bonded to the SNAP 10A NaK coolant system, and a radiant type that can be removed upon completion of system checkout. The radiant type satisfied the system requirement of essentially zero weight penalty; it utilizes tantalum ribbon elements and beryllia insulators, operating in a 10×10^{-2} torr environment. Both heater designs have been fabricated and have passed stringent qualification tests. The reactor-simulator heater is required to simulate the thermal, hydraulic and mass characteristics of the nuclear reactor. A prototype reactor simulator demonstrated the inadequacy of standard electrical, high-watt density, heater cartridges exposed to SNAP 10A operating conditions. Modifications of the cartridges were made to prevent NaC in-leakage, and to provide a power lead configuration which was not susceptible to arc-over failure upon exposure to contaminated vacuum environments. Author

N65-19061 Naval Research Lab., Washington, D. C. Metallurgy Div.
NEUTRON EMBRITTLEMENT OF REACTOR PRESSURE VESSEL STEELS
L. E. Steele *In its* Rept. of NRL Progr. Nov. 1964 p 8–17 refs (See N65-19059 09-23)

The concept of the fracture analysis diagram was used to assess the significance of radiation damage which was studied in terms of steel composition, the neutron dose and the irradiation temperature. For many of the steels studied, postirradiation heat treatments were found to be effective in restoring ductility. Author

N65-19332# Hanford Atomic Products Operation, Richland, Wash. Chemical Lab.
PROGRESS IN FISSION RECOVERY AT HANFORD, 1954–1964
R. L. Moore Nov. 1964 30 p refs
(Contract AT(45-1)-1350)
(HW-83609) CFSTI: $2.00

Progress in fission product recovery of cesium, strontium, cerium, promethium, and technetium is reported. The waste management program and the isotope production plant study are discussed. Cesium-137 (half-life 30 years, fission yield 6%) was the first fission product to receive attention in the development program. Strontium-90 is a favored isotope for nuclear heat-source use because of high fission yield (5.8%), long half-life (28 years), and reasonably high specific power (about 0.95 W/g). Cerium-144 is a potent heat-generating isotope which has not as yet received large-scale utilization, largely because of the presence of a (low abundance) penetrating gamma which requires extensive shielding. E.E.B.

N65-19333# Hanford Atomic Products Operation, Richland, Wash. Chemical Lab.
PROGRESS IN RADIOACTIVE RESIDUE PROCESS DEVELOPMENT, 1958–1964
A. M. Platt and C. R. Cooley Nov. 1964 38 p refs
(Contract AT(45-1)-1350)
(HW-83610) CFSTI: $2.00

Programs for the solidification of the high-level radioactive wastes are now in final laboratory and engineering scale development in preparation for demonstrations using fully radioactive prototypes. The basic operability of the process of calcination for the treatment and disposal of the high-level chemical processing wastes (Purex and Redox) was demonstrated. A small, integrated, pilot plant has been constructed for remote operation. Major accomplishments of the spray calciner program are reported. Work accomplished on the

treatment of medium level waste has lead to the consideration of multiple effect evaporation, and the application of the ion exchange method for removal of radioisotopes from waste streams. E.E.B.

N65-19337# Argonne National Lab., Ill.
EXPERIMENTAL INVESTIGATIONS OF SECONDARY CRITICAL CONFIGURATIONS (ZPR-III ASSEMBLIES 27 AND 28)
W. Gemmell, J. K. Long, and W. P. Keeney Nov. 1964 37 p refs
(Contract W-31-109-ENG-38)
(ANL-6866) CFSTI: $2.00

Two configurations of a fast reactor core following a postulated accidental meltdown were investigated. The configurations were chosen to represent nonuniform distributions of fuel in which calculations of flux and reactivity worth could be compared with experimental values. The first configuration represented a case in which the center of a core had melted, and the top and center portions had collapsed into a dense fuel mass in the bottom of the reactor. The second configuration represented a core in which vaporizing sodium caused the expulsion of all material from the axis of the core, and the annulus had melted and collapsed into a dense ring of fuel. In an actual meltdown, a secondary critical or supercritical configuration of fuel could occur, which would be governed by the spatial relationships of the fuel worth, power distribution, and degree of criticality. The relationship of the power and fuel-worth distributions would determine if further motion of the fuel would result in an autocatalytic configuration. The experiments provided fission-rate and reactivity-worth distributions for evaluating calculational methods designed to describe possible accident configurations. Author

N65-19340# Atomics International, Canoga Park, Calif.
APPLICATION OF NUCLEAR POWER PLANTS (SNAP UNITS) TO THE MANNED ORBITING RESEARCH LABORATORY (MORL)
W. V. Botts, M. Marko, P. E. Mc Court, V. Keshishian, A. R. Piccot et al 1 Feb. 1965 95 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-10318) CFSTI: $2.25

This report describes two designs of a nominal 6-kWe nuclear power plant (NPP), one using thermoelectrics for power conversion and the other using the Mercury-Rankine cycle. The integration of the NPP into the Manned Orbiting Research Laboratory (MORL) is given. In addition, detailed discussions are presented on the NPP operational and integration requirements as defined by the MORL mission, nuclear shielding parametric and design data, nuclear hazards and safety criteria and design, NPP deployment subsystem design and analysis, and the developmental requirements to meet the MORL schedule. Author

N65-19344# European Atomic Energy Community, Brussels (Belgium).
MAC-RAD, A REACTOR SHIELDING CODE
J. Canali, H. Ilsemann, C. Ponti, and H. Preusch 1964 124 p refs
(EUR-2152.e) Available from The Belg. Am. Bank and Trust Co., New York account no. 22.186: 185 Belg. Fr.

This program gives, for slab geometries, the following information as a function of distance from the core boundary: multigroup neutron fluxes neutron dose rates, and approximate neutron spectrum. Author

N65-19406# Hanford Atomic Products Operation, Richland, Wash.
PROGRESS IN PLUTONIUM UTILIZATION, 1956–1964
O. F. Hill and H. M. Parker Dec. 1964 211 p refs
(Contract AT(45-1)-1350)
(HW-83601) CFSTI: $6.00

Progress on plutonium fuel cycle analysis, plutonium reactor physics, reactor engineering development, materials development, plutonium fuels processing, and the plutonium recycle test reactor operation is reported. E.E.B.

N65-19415# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS DURING DECEMBER 1964
Russell W. Dayton and Stan J. Paprocki 1 Jan. 1965 49 p
(Contract W-7405-ENG-92)
(BMI-1707(DEL)) CFSTI: $1.25

Reports issued on civilian applications of atomic energy are listed. Also, progress is reported on the following major areas of research: reactor materials and components, fuels, radioisotope and radiation applications, coated-particle fuel materials, corrosion studies of the fluoride-volatility process, gas-cooled reactor program, and development of small radioisotopic power sources. E.E.B.

N65-19422# Hanford Atomic Products Operation, Richland, Wash. Separations Chemistry Lab.
THE GAMMA ANALYTICAL SYSTEM AT REDOX
W. H. Zimmer Sep. 1964 53 p refs
(Contract AT(45-1)-1350)
(RL-SEP-46) CFSTI: $3.00

The gamma analytical system at Redox uses linear equations to determine activity components in a system of mixed isotopes. An IBM 7090 computer program was installed to accomplish this; another program formulates the linear equation components from direct calibrations for use in the solutions. Counting geometries and analyzer response functions are held constant with the aid of a system of routine checks. Through the use of this system, it was possible to provide accurate, nondestructive gamma energy analysis over a wider range of activities, and in more complex mixtures than could be provided by any other known system. This versatility was accomplished without affecting the accuracy of energy analysis of single isotopes and simple isotopic mixtures. Author

N65-19445# Naval Research Lab., Washington, D. C. Metallurgy Div.
YANKEE REACTOR PRESSURE VESSEL SURVEILLANCE: EVALUATION OF SPECIMENS EXPOSED DURING THE SECOND CORE
C. Z. Serpan, Jr., H. E. Watson, J. R. Hawthorne, and L. E. Steele 24 Nov. 1964 19 p refs
(NRL-6179: AD-609565)

Although the four capsules were located in physically identical positions about the fuel core, they were subject to widely different neutron exposures (>1 MeV). The Charpy-V transition temperature increase of the Yankee pressure vessel steel, which was irradiated together with a reference steel of the same nominal composition in the same capsules, was somewhat larger than the increase of the reference steel. The data from the reference steel followed closely the trend line of transition temperature increase versus total neutron exposure, previously established for 540° F irradiations, but that for the Yankee vessel steel was displaced almost 100° F higher than the reference steel. Postirradiation annealing

was beneficial for the three heat-treatment conditions studied, and, in one case, essentially complete recovery of initial properties was observed. The study demonstrated the usefulness of accurate dosimetry data for each surveillance specimen, and the importance of measurements of the neutron dosage to which the monitored reactor component is exposed. Author

N65-19525# Atomic Energy Information Service, Frankfurt Am Main (West Germany).
AED INFORMATION SERVICE. SERIES C: BIBLIOGRAPHIES. SECTION 22: NUCLEAR SHIP PROPULSION
J. N. Paro, comp. Dec. 1964 51 p refs In GERMAN and ENGLISH *Its* RCN-Mededeling No. 13
(AEC-C-22-03)

The task of supplying scientific and technical information to scientists and engineers in the nuclear energy field, who are assigned to the Atomic Energy Documentation Center in the Federal Republic of Germany is explained. A bibliography with author index is presented for nuclear ship propulsion. E.E.B.

N65-19535# Los Alamos Scientific Lab., N. Mex.
ADVANCED REACTOR TECHNOLOGY (ART) Quarterly Status Report, Period Ending Jan. 31, 1965
3 Mar. 1965 59 p
(Contract W-7405-ENG-36)
(LA-3244-MS) CFSTI: $3.00

Several areas of reactor development are reported: (1) tests on plutonium reactors and fuels, (2) corrosion tests on containers for Pu-Co-Ce reactor fuel, (3) thermal conductivity tests of graphite–uranium fuel elements in the UHTREX reactor, and (4) feasibility study of a nuclear reactor–MHD closed Brayton cycle. J.M.D.

N65-19555# Polish Academy of Sciences, Warsaw. Institute of Nuclear Research
MACROSCOPIC NEUTRON DISTRIBUTIONS IN THE TWELVE-ELEMENT CORE OF ZERO POWER REACTOR ANNA
L. Adamski, E. T. Jozefowicz, and K. Jozefowicz Nov. 1964 26 p ref
(Rept.-563/IX-A) Available from Nuclear Energy Inform. Center, Warsaw

The results of measurements of macroscopic distributions of neutron density, cadmium ratio and spectral index γ in the twelve-element core of ANNA reactor are presented. The results include vertical distributions in water and graphite channels, distributions along the two main horizontal axes as well as in the horizontal plane of symmetry. Author

N65-19565# European Atomic Energy Community, Brussels (Belgium).
NON-DESTRUCTIVE TESTING OF ORGEL TUBULAR FUEL CANS [TESTS NON DESTRUCTIFS SUR TUBES DE GAINE ORGEL]
P. Bonnet, E. Borloo, and J. Jansen 1964 70 p In FRENCH; ENGLISH summary Presented at the Journées Métallurgiques D'Automne, Paris, 14–18 Oct. 1963
(EUR-2109.f) Available from the Belg. Am. Bank and Trust Co., New York Account No. 22.186: 100 Belg. Fr.

The control of tubes to be used in the ORGEL reactor is carried out by different techniques sensible to diverse kinds of defects. The comparative efficiency of various methods is analysed. The ultrasonic method seems the most suitable. The choice of the immersion method, the detection of defects of axial or circumferential orientation, the reflection (one single transducer) or transmission method (two transducers) as well as the use of focalised transducers are mentioned. The various methods are compared and three types of fittings described which are intended to investigate tubes in the laboratory or within a semi-industrial context. The radiography may be retained for intersection and control purposes if contrast and resolution are carefully worked out. A single wall technique, the so-called radiorotative technique, is described. Calculations have been initiated on the interaction of various parameters such as time and resolution. Investigations have been made on eddy currents in the field of pulses. Various techniques of visual examination (penetrant liquids, latex replica) and dimensional measures have been tested and compared. Author

N65-19608# Commissariat a l'Energie Atomique, Fontenay-aux-Roses (France). Departement de Recherche Physique
FAST NEUTRON BREEDER REACTOR RAPSODIE—SITUATION OF PHYSICS, HYDRAULIC, THERMAL AND DYNAMICS STUDIES AND STUDIES OF STABILITY EARLY IN 1963 [RAPSODIE—POINT DES ETUDES NEUTRONIQUES, HYDRAULIQUES, THERMIQUES ET DYNAMIQUES ET DES ETUDES DE STABILITE AU DEBUT DE L'ANNEE 1963]
Brussels, EURATOM, Nov. 1964 103 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-006-62-1 RAAF)
(CEA-2450; EUR-1807.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 85 Belg. Fr.

To make a choice between the two fuels examined for Rapsodie—the UPuMo alloy with double cladding, Nb and stainless steel, and the UO_2-PuO_2 mixed oxide—studies were effected and are reported. Given are the most important physics performances of the two cores—neutron flux and spectrum, reactivity of the compensation and safety rods, neutrons balance, specific power, effective fraction of delayed neutrons, lifetime of the prompt neutrons, and reactivity coefficient. The following are discussed: the hydraulic studies and experiments done concerning the two cores; the criteria adopted as basis for the flow calculations; the results of pressure drop and subassembly lifting, force measurements, and vibration and pin flow distribution experiments; the constants utilized for the thermal calculations; and the temperatures of sodium and alloy or oxide fuel, the temperature increases due to the hot points, and the limitation of the oxide fuel burnup. Author

N65-19654# Oak Ridge National Lab., Tenn. General Engineering and Construction Div.
HIGH-DENSITY CONCRETE FOR GAMMA AND NEUTRON ATTENUATION
T. E. Northup Mar. 1965 75 p refs
(Contract W-7405-ENG-26)
(ORNL-3704) CFSTI: $3.00

The special aggregates needed to produce concrete shields capable of attenuating high and almost equal intensities of gamma and neutron radiation at a temperature of 100°C are described in this report. Material acquisition and concrete test information on ferrophosphorus–limonite concrete and hydrous–iron–ore–limonite concrete is presented. Special appendixes cover high-density aggregate mining, iron–pyrite impurities in hydrous iron ore, and shielding aggregate data tables. The basic approach to high-density concrete mix design is reviewed to show that theoretical calculations for concrete mixes give results that are reliable. However, laboratory tests with the produced shielding aggregates are still required to confirm mix quantities, adjust workability, establish the need for additives, etc. before any concrete is actually placed. Author

N65-19661# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
DIFFUSION IN THE STABLIZED ZIRCONIA-URANIA SYSTEM
D. R. Mash and K. K. Ikeuye Nov. 1964 44 p refs
(Contract AT(10-1)-205)
(IDO-17006)

To measure penetration of zirconia cladding by urania at elevated temperatures, natural UO_2 cored pellets were coated by the plasma-spray technique. Uniform coatings of about 89% theoretical density were applied using carefully controlled process conditions. Diffusion annealing treatments were carried out in the 2000° to 2450° C range for 8-hour periods in helium. Diffusion zone characteristics, observed metallographically, provided evidence of relatively complicated interactions taking place in this ternary system at temperatures close to the melting point of the coating. The ZrO_2-UO_2 interface region after diffusion included a void zone, a ternary solid solution zone, the moving boundary, and a high density zirconia-rich zone. A penetration coefficient, K, which is proportional to the diffusion coefficient, was measured as a function of temperature and the results were correlated by means of the usual rate equation. Based on the results, it can be concluded that diffusion in the stabilized ZrO_2-UO_2 system is strongly temperature dependent; however, even at temperatures close to the melting point of zirconia, uranium would not completely penetrate a 0.050-inch coating after 8 hours.
Author

N65-19667# Atomics International, Canoga Park, Calif.
THERMO-PHYSICAL PROPERTIES OF IRRADIATED POLYPHENYL COOLANTS. PART I: DENSITY AND VISCOSITY
R. H. J. Gercke and G. Asanovich 1 Dec. 1960 58 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-4484) CFSTI: $1.25

Density, viscosity, and melting point were determined for five organic materials considered for use as organic reactor coolants. The properties were determined for irradiated coolants over the temperature range of 300° to 800° F and as a function of high boiler or polymer concentration in the range of 0 wt.% to 40 wt.%. The following polyphenyl coolant mixtures were studied: (1) a mixture of 2/3 ortho- and 1/3 metaterphenyl; (2) a mixture of ortho-, meta-, and paraterphenyl; (3) diphenyl; (4) monoisopropyldiphenyl; and (5) a polyphenyl mixture used as the coolant in the Organic Moderated Reactor Experiment (OMRE) mainly consisting of ortho- and metaterphenyl with smaller quantities of diphenyl and paraterphenyl. The first four coolant mixtures above were irradiated in a circulating inpile loop. The changes in the properties of these coolants are compared to the results of the OMRE (reactor) irradiation.
Author

N65-19669# Hanford Atomic Products Operation, Richland, Wash. Chemical Lab.
A REVIEW OF RESEARCH ON PLUTONIUM RELEASES DURING OVERHEATING AND FIRES
J. Mishima Aug. 1964 25 p refs
(Contract AT(45-1)-1350)
(HW-83668) CFSTI: $2.00

Articles and documents reviewed are concerned with oxidation and ignition temperatures of metallic and delta-phase stabilized plutonium, particle size distribution of oxide produced by heating plutonium and some of its compounds, deposition from turbulent streams, resuspension of plutonium dioxide particulate material from various surfaces, or release of plutonium during experimental and accidental fires. In most instances, plutonium oxidation rates are found to increase with increasing temperature and humidity. A minimum rate is found in the delta-phase region due to changes in the oxide layer. Ignition can occur at temperatures above 100° C depending upon the conditions of the metal and heating. The rate of release of plutonium dioxide aerosol increases with increasing temperature and gas velocity.
Author

N65-19820# Westinghouse Electric Corp., Pittsburgh, Pa. Atomic Power Div.
MELTING POINT OF IRRADIATED URANIUM DIOXIDE
J. A. Christensen, R. J. Allio, and A. Biancheria Feb. 1965 22 p refs
(Contract AT(30-1)-3017)
(WCAP-6065)

The melting point of nearly stoichiometric, sintered UO_2 irradiated for 2000, 9500, 13 500, 18 000, 29 500, and 52 000 MWD/MTU was measured optically using the Mendenhall V technique. A nearly linear decrease at a rate of 32° C/10 000 MWD/MTU from 2800° C at zero exposure to 2640° ± 30° C at 52 000 MWD/MTU was observed.
Author

N65-19825# Atomics International, Canoga Park, Calif.
REFABRICATION AND ENCAPSULATION OF HIGHLY IRRADIATED URANIUM DIOXIDE
J. Guon, J. E. Bodine, and R. J. Sullivan 1 Dec. 1964 57 p refs
(Contract AT(11-1)-GEN-8)
(NAA-SR-8213) CFSTI: $1.25

One hundred-gram quantities of uranium dioxide, irradiated to burnups as great as 21 000 Mwd/MTU and previously reprocessed by AIROX (Atomics International Reduction Oxidation), were refabricated into high density pellets and encapsulated for reirradiation. Pellets were fabricated by cold pressing and sintering. Average densities, calculated from gas displacement and geometrical measurements, were 95.5% and 92.8% of theoretical density, respectively. Variation in pellet diameter, within a powder batch, was less than 0.002 in. Radiochemical analyses indicated that the principal fission products removed were cesium and the noble gases, and that plutonium was effectively retained during the processing cycle. All basic refabricating operations required for a large scale AIROX plant, except fuel reenrichment (not considered a difficult operation), were successfully demonstrated.
Author

N65-19841# Douglas Aircraft Co., Inc., Santa Monica, Calif. Nuclear Dept.
CONCEPTUAL DESIGN ANALYSIS OF A 5 MWE THERMIONIC REACTOR SPACE PROPULSION PLANT
F. A. Ross and T. F. Plunkett Feb. 1965 158 p refs
(SM-46275)

The conceptual design of a 5-MWE thermionic reactor propulsion plant is presented. Thermionic emission characteristics are evaluated for a cylindrical power converter incorporating a 60 v/o uranium dioxide–tungsten cermet fuel, a tungsten emitter and alternative collector materials. Optimization of the reactor and the associated primary coolant and heat rejection systems results in an average emission temperature of 2195° to 2285° K, and an average radiator coolant temperature of 1595° F under rated operating conditions. The specific weight of the overall propulsion plant incorporating electron bombardment ion engines is 19.4 lb/KWE, including radiator structure and a reactor shielding weight of 2.8 lb/KWE. The plant design features a high degree of reliability through the provision of redundancy, which accounts for approximately 10% of the plant weight. Application of an electromagnetic thrustor provides a potential decrease of about 4.6 lb/KWE

in plant weight through the reduction in power conditioning requirements. Relocation of the engine to be close to the reactor would further reduce the weight by another 1 lb/KWE. Author

N65-19990# Army Chemical Center, Edgewood, Md. Nuclear Defense Lab.
NEUTRON FLUX MEASUREMENTS AT THE DIAMOND ORDNANCE RADIATION FACILITY
David T. Kilminster, Jean Kappes, and John H. Mc Neilly Feb. 1965 36 p refs
(NDL-TR-56; AD-458635)

The threshold detector system was used to measure the neutron flux environment at various points around the DORF-Triga Mark F reactor. A total of 247 measurements were made in the exposure room and the pool with the reactor in the pulse mode. An additional measurement was made in the exposure room with the reactor in the steady-state mode. The neutron flux was monitored by placing a set of threshold detectors on the upper grid plate of the reactor core during each pulse. Neutron flux measurements are reported in units of neutrons per square centimeter. Author

N65-20004# General Dynamics/Fort Worth, Tex.
INDUCED-VOLTAGE STUDIES IN A COBALT-60 GAMMA IRRADIATOR Technical Report, 1 Oct. 1963–30 Sep. 1964
L. W. Nelms Kirtland AFB, N. Mex., AF Weapons Lab., Feb. 1965 52 p
(Contract AF 29(601)-6213)
(FZK-214; WL-TR-64-149; AD-612071)

An investigation into the basic mechanism of gamma-radiation-induced current and voltage in electrical systems was started by using a 1500-curie Co^{60} radiation source. Steady-state measurements of electric potentials induced in a specially constructed hollow cylindrical capacitor as a function of gamma field direction, gamma field strength, and apparatus temperature are described. From these data, it is concluded that the Compton process is the dominant mechanism involved. A theory is developed explaining in detail how electrons from Compton collision might produce currents in a simple insulator–conductor system. The validity of the developed equations was tested by experimentally investigating the dependence of induced current upon gamma field intensity and upon thickness of dielectric interposed between the electrode and the radiation source. It was found that, within the narrow range of gamma field intensity available, the induced current depended linearly upon field intensity, as the equation predicted. The tests of the dependence of induced current are not complete, but early data show a trend consistent with results predicted by the equation. Author

N65-20073# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SOME METHODS OF CALCULATION OF THE PARAMETERS IN THE REACTOR KINETICS EQUATIONS
G. E. Putnam Feb. 1965 90 p
(Contract AT(10-1)-205)
(IDO-16983) CFSTI: $3.00

The spatially independent form of the reactor kinetics equations is written in terms of several time-dependent parameters; namely, the reactivity $\rho(t)$, the delayed neutron fraction $\bar{\beta}(t)$, the prompt neutron lifetime $\Lambda(t)$, the concentration of the i^{th} species of delayed neutron procursor $c_i(t)$, and the source $Q(t)$. Ways of computing the values of the parameters according to previous formulas are described in detail, with the emphasis given entirely to methods which utilize practically any of the commonly available reactor computer codes without recourse to the calculation of neutron importance functions. Methods are outlined which lead to an indirect evaluation of the commonly encountered integrals of functions weighted by the importance function; that is, the methods involve no integration. In the appendix, the arbitrariness of the definitions of some of the parameters is discussed and several different but equally valid sets of definitions are given by way of example. The criterion for the consistency of a set of definitions is given. Author

N65-20094# Compagnie pour l'Etude et la Realisation de Combustibles Atomiques, Bonneuil-sur-Marne (France).
THEORETICAL AND TECHNOLOGICAL STUDY OF NUCLEAR FUELS BASED ON COMPOSITE REFRACTORY PELLETS [ETUDE THEORIQUE ET TECHNOLOGIQUE DE COMBUSTIBLES NUCLEAIRES A BASE DE PASTILLES REFRACTAIRES COMPOSITES]
J. Doumerc, G. Troccon, and R. Hauser (CICAF) Brussels, EURATOM, Nov. 1964 64 p refs In FRENCH; ENGLISH summary
(Contract EURATOM-77-61-12 RDF)
(EURAEC-649; EUR-1249.f) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186; 85 Belg. Fr.

This study relates to a fuel consisting of composite pellets in which a ring of fissile material (UO_2) is arranged around a fertile core (ThO_2). This peripheral arrangement of the UO_2—the only material that generates heat at the start of operation—reduces the thickness of refractory material separating the innermost heat sources from the cooled surface and enables the thermal flux at the surface of the fuel, i.e., its specific power, to be increased, while the temperature of the internal UO_2 surface is still kept below the critical value. The replacement of UO_2 by a U^{238}/Th^{232}-type fuel could result in a 40% power increase and, given a depletion rate of 20 000 MWd/ton, a 25% reduction of the kWh cost. The fabrication tests with composite pellets related essentially to the study of the rough shrink-fitting of green UO_2 onto sintered ThO_2; the results obtained were encouraging. Hot stability tests on the pellets thus prepared showed that the UO_2/ThO_2 diffusion is very slight and that the thermal resistance at the surface of contact between the two elements is negligible. The above process is, however, expensive and it would be interesting to resume the tests with processes requring only a single sintering operation (co-extrusion, rough shrink-fitting). Encouraging attempts have been made to adapt the shrinkage of the two elements. Author

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N65-18632# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACOUSTIC CONDUCTIVITY OF A RIGID BURNING SURFACE
S. S. Novikov and Yu. S. Ryazantsev 18 Mar. 1963 11 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Tekhn. Fiz. (Moscow), no. 6, 1961 p 73–77
(FTD-TT-62-1690/1+2; AD-402463)

Previous investigations of the acoustic properties of a shock front, such as the front of a flame, are reviewed. The

concept of a plane front of burning in the case of the burning of condensed systems is developed. The problem is of interest because the magnitude of acoustic conductivity determines the boundary condition on burning surfaces in existing theories of resonance burning. Burning laws for condensed systems are given. Instantaneous values for the combustion product outflow rate and the pressure, and conclusions for the generalization in the case of compressible condensed phases are included. E.E.B.

N65-18635# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IONIZATION METHODS OF OBTAINING HIGH VACUUM
E. M. Reykhrudel' and G. V. Smirnitskaya 12 Mar. 1963 11 p refs Transl. into ENGLISH from Priroda (Moscow), no. 9, 1957 p 87–91
(FTD-TT-62-1914/1+2; AD-402467)

A review of ion pump and vacuum tube technology indicates that existing methods and equipment satisfy present laboratory and industrial requirements with respect to pumping output power and maximum pressure. However, inherent deficiencies of the ion pumps described appear to be the relatively narrow working range of pressures (10^{-3}–10^{-6} mm Hg), and filament evaporation of incandescent cathodes which reduces service life. E.P.V.

N65-18645# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OSCILLATIONS OF A PHYSICAL PENDULUM HAVING CAVITIES FILLED WITH A VISCOUS FLUID
P. S. Krasnoshchekov 10 Jun. 1963 17 p ref Transl. into ENGLISH from Prikl. Mat. i Mekh. (Moscow), v. 27, issue 2 p 193–202
(FTD-TT-63-511/1+2+4; AD-410057)

An asymptotic method has been proposed for investigating the nonstationary motions of viscous incompressible fluids with large Reynolds numbers (N_{Re}), which arise during the oscillation of various solids that either contain a fluid or are emersed in one, and also during the oscillation of liquid volumes having a free surface. In this article the idea of this method is applied to the investigation of small oscillations of a physical pendulum having cavities completely filled with an incompressible viscous fluid. Author

N65-18671# Polytechnic Inst. of Brooklyn, N. Y. Microwave Research Inst.
ON THE RELATION BETWEEN POLE WAVES AND LATERAL WAVES IN SLAB CONFIGURATIONS
Theodor Tamir and L. B. Felsen 12 Nov. 1964 refs
(Contract AF 19(628)-2357)
(PIBMRI-1245-64; AFCRL-64-988; AD-610584)

The customary analysis of radiation from sources in the presence of a dielectric slab involves a plane wave superposition wherein the boundary conditions are satisfied by a single composite reflection coefficient. The far field is then comprised of the incident and reflected waves as well as a diffracted contribution of surface and leaky waves (pole waves). An alternative formulation is discussed wherein the interface effects are accounted for one at a time and the resulting diffraction field is then shown to involve lateral waves (branch cut waves). The two representations are compared. When the source and observation points are located exterior to a large dielectric gap, diffraction effects due to an accumulation of leaky waves are found to be equivalent to a single lateral wave. For source and observation points inside a lossy dielectric slab, the pole wave formulation provides a somewhat more convenient result. Author

N65-18873# Windsor Univ. (Ontario).
LIQUID-LIKE (TRANSITION) LAYER ON ICE
H. H. G. Jellinek Hanover, N.H., Army Cold Reg. Res. and Lab., Oct. 1964 24 p refs
(Contract DA-ENG-27-021-62-G1)
(CRREL-SR-70; AD-609328)

A survey of the literature covering about the last hundred years is presented concerning the existence of a liquid-like transition layer on ice below its melting point. The conclusion is reached that the available evidence is very strongly in favor of the existence of such a layer. However, more direct measurements of the properties of such a layer are needed and possible methods for obtaining such information are indicated. Author

N65-18894# Columbia Univ., New York. Stanley-Thompson Lab.
ELECTRICAL PHENOMENA AT THE ICE/WATER INTERFACE
Jack H. Schulman and H. C. Parreira Jun. 1964 25 p refs
(Contract Nonr-266(64))
(TR-1; AD-601703)

Automatic recording apparatus for streaming potentials, and a device for producing and measuring freezing potentials were designed. Streaming potentials are generated whenever liquid water is forced through ice capillaries under pressure gradients. Freezing potentials appear during the freezing of water dilute aqueous solutions. Equipment discussed includes the streaming potential cell, with its associated solution reservoirs, pressure ballast, pressure transducer, and electronic circuit, and the freezing potential cell, with its freezing well and measuring–recording device. E.P.V.

N65-18984# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.
ON THE PHYSICAL NECESSITY FOR GENERAL COVARIANCE IN ELECTROMAGNETIC THEORY
E. J. Post Dec. 1964 28 p refs *Its* Special Rept.-16
(AFCRL-64-997; AD-610060)

This paper reviews the essentials of the principle of general covariance and emphasizes the points of contrast with the more restricted but more accepted forms of covariance, such as Lorentz covariance. It is emphasized that the implementation of general covariance should aim at a maximized functional separation between the formulation of the physical laws and the description of the specific physical system or medium under consideration; uniqueness of the implementation is determined by choosing dependent variables that bring out the functional separation. The invariance group of the law should be a covering group of the symmetry group characterizing the system or medium to which the law is applied. The procedure, which removes existing paradoxes and inconsistencies, is illustrated by examples from electromagnetic theory. A discussion of general principles helps to establish unique procedures for the implementation of general covariance. Author

N65-18995# General Electric Co., Philadelphia, Pa. Spacecraft Dept.
MAGNETIC HYSTERESIS DAMPING OF SATELLITE ATTITUDE MOTION, VOLUME I Final Report
16 Nov. 1964 75 p refs
(Contract N178-8450)
(DOC.-64SD5242; AD-610465)

The attitude dynamics of a gravity-gradient oriented satellite, which employs soft nickel–iron rods as magnetic hysteresis dampers, is simulated by a digital computer program. A subroutine was generated to compute the flux induced in the rods

for an arbitrary vehicle orientation relative to the earth's magnetic field vector. This subroutine was added to an existing computer program. Analytical expressions were fitted to empirical major and minor hysteresis loops, and a logic scheme was devised for tracing BH curves with an arbitrarily fluctuating applied magnetic field. This enabled simulation of the effects due to the magnetic field encountered in orbit. This report describes the analysis and the computer program in detail. Author

N65-19020# General Technology Corp., Elgin, Ill.
APPROXIMATE METHODS OF SIMULATING RANDOM NOISE WITH PURE TONE SOURCES Technical Report No. 4-3, May 1963–Jun. 1964
C. C. Thiel Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1964 71 p refs
(Contract AF 33(657)-10945)
(FDL-TDR-64-131; AD-611271)

The problem of the approximation of a given random signal with modulated pure-tone signals is studied from the standpoint of approximation of the power spectrum. The equal energy and moment matching techniques are developed for the selections of the modulation parameters of the pure-tone sources. Techniques are developed for the selection of parameters of a switched pure-tone source. The power spectrum is also approximated by a rational polynomial scheme, which uses a minimax procedure for selection of pure-tone operating parameters. Several examples of each of these techniques are given. Author

N65-19059# Naval Research Lab., Washington, D. C.
REPORT OF NRL PROGRESS
Nov. 1964 56 p refs
(AD-609535)

CONTENTS:

1. POLARIZERS FOR THE EXTREME ULTRAVIOLET W. R. Hunter p 1–7 refs (See N65-19060 09-23)
2. NEUTRON EMBRITTLEMENT OF REACTOR PRESSURE VESSEL STEELS L. E. Steele p 8–17 refs (See N65-19061 09-22)

N65-19060 Naval Research Lab., Washington, D. C. E. O. Hulburt Center for Space Research
POLARIZERS FOR THE EXTREME ULTRAVIOLET
W. R. Hunter *In its* Rept. of NRL Progr. Nov. 1964 p 1–7 refs Presented at the ICO Conf. on Phot. and Spectroscopic Optics, Tokyo, Sep. 1964 (See N65-19059 09-23)

The polarizing properties of materials in the extreme ultraviolet are being studied for the purpose of developing both reflecting and transmitting polarizers. Calculations were made for some of those materials whose optical constants were measured, and an attempt was made to verify the calculated ratios experimentally where possible. The calculations indicate the possibility of making transmitting polarizers, using multilayer unbacked metal films, for wavelengths less than the critical wavelength of the metal. Reflecting polarizers, which are much less convenient to use, show more complete polarization. Author

N65-19090# General Dynamics/Astronautics, San Diego, Calif. Space Sciences Lab.
HIGH-TEMPERATURE SPECTRA OF THE PURE ROTATIONAL BAND OF H_2O
C. B. Ludwig, C. C. Ferriso, W. Malkmus, and F. P. Boynton Dec. 1964 38 p refs
(Contract Nonr-3902(00); Proj. Defender)
(GDA-DBE64-069; AD-610362)

The short wavelength wing of the pure rotation emission spectrum of water vapor was measured at temperatures between 550° and 2200° K and at a nearly constant optical depth of 2.4×10^{-4} g/cm^2. Apparent line positions and relative intensities agree with those determined from previous work. An approximate calculation of the local mean spectral absorption coefficient was performed. This calculation is the weighted mean value of results obtained using energy levels of the prolate spheroidal top and of the most asymmetric top. A comparison of the results of the calculation (applying the statistical band model using parameters obtained in vibration-rotation bands) with the experimental data indicates that the calculation is acceptable for the long wavelength contribution to the total emissivity of hot water vapor. An estimate of the integrated band intensity was obtained. Author

N65-19145# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PROBLEM OF IRREGULARITY OF ASYMPTOTICS OF A VARIABLE ELECTROMAGNETIC FIELD OF A QUASISTATIONARY DIPOLE
L. L. Van'yan 2 Feb. 1965 6 p refs Transl. into ENGLISH from Geol. i Geofiz, Akad. Nauk SSSR, Sibirsk. Otd. (Novosibirsk), no. 10, 1963 p 160–162
(FTD-TT-65-77/1+2; AD-611055)

The irregularity of asymptotic behavior of a vertical magnetic field component of a horizontal electric dipole situated on the surface of double layer medium is reviewed, and the modulus of the apparent specific resistance developed. The nature of the transition from the first asymptote is also considered. E.E.B.

N65-19172# St. Louis Univ., Mo.
ELECTRONIC AND NUCLEAR PARAMAGNETISM AND ENERGY EXCHANGE MECHANISMS Interim Report No. 1, Sep. 1963–Sep. 1964
W. A. Barker, R. K. Jeck, S. K. Misra, and R. F. O'Brien Griffiss AFB, N.Y., RADC, Dec. 1964 119 p refs
(Contract AF 30(602)-2907)
(RADC-TDR-64-455; AD-611184)

It was shown that the Na and Li nuclear magnetic resonance signal may be enhanced in NaCl and LiF by the EPR pumping of "forbidden" transitions in which advantage is taken of the coupling between the Cl_2^- center or the F_2^- center and the host alkali nucleus. Evidently these centers affect the adjacent anion nuclei first and then this local polarization becomes rapidly diffused from one alkali nucleus to the next. This requires a spin diffusion rate which is fast compared to the nuclear spin lattice relaxation rate. A successful phenomenological theory was developed to explain these effects at liquid N_2 temperatures. Author

N65-19297# RAND Corp., Santa Monica, Calif.
IS LASER RADIATION CLASSICAL?
Dennis Holliday and A. E. Glassgold Jan. 1965 9 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4435-PR; AD-610953)

An attempt is made to solve the quantum mechanical equations of motion for an ideal laser, by using the concept of classical motion in quantum mechanics precisely. It is shown that the laser produces a classical field while undergoing linear self-amplification. The nonlinear behavior which follows the linear

amplification then leads to amplitude stabilization of this classical field; the phase of the field will be uniformly distributed.
Author

N65-19324# Navy Mine Defense Lab., Panama City, Fla.
ATTENUATIONS OF RAYLEIGH-SHEAR AND STONELEY WAVES, AND GEOMETRIC SCALING LAWS IN FLUID–SOLID MODELS
V. C. Nelson, F. R. Spitznogle, and E. G. Mc Leroy Jan. 1965 46 p refs
(I-67; AD-454084)

The scaling laws concerning theoretical and model results for an impulsive sound source in a fluid–solid system are investigated. The results of a study of the amplitude attenuations of the Rayleigh-shear and Stoneley waves with variations in the source-detector, source-interface, and detector-interface separations are presented. Available theoretical techniques adequately describe such attenuations. Changes in the frequency spectra of the pressure waveform from such sources are also given for the same geometrical variations.
Author

N65-19366# American Meteorological Society, Boston, Mass.
DOUBLE REVERSING PRISMS [DIE UMKEHRPRISMEN]
A. König Bedford, Mass., AFCRL, Aug. 1964 13 p refs Transl. into ENGLISH from the book "Handbuch der Experimental-Physik" Leipzig, Akad. Verlagsgesellschaft, v. 20, pt. 2, chapter 10, sect. 4, pt. D, 1929 p 206–212
(Contract AF 19(628)-3880)
(T-G-231^{+}; AD-454625)

The following prisms are discussed: rectangular, Delaborne, direct-vision roof, deflecting roof, Abbe roof, Leman roof, Porro double reversing, Schmidt roof, Möller roof, and Daubresse back-vision prisms. Although not discussed, mention is made of a variant to the Porro double reversing prism in which the angles of incidence at the reflecting surfaces are greater than 45°.
E.E.B.

N65-19424# Colorado Univ., Boulder.
EXPERIMENTAL PROGRAM TO DETERMINE THE THERMODYNAMIC PROPERTIES OF SOLUTIONS OF LIQUEFIED LIGHT GASES Technical Documentary Report, Apr. 1962–Oct. 1964
Paul L. Barrick and Richard N. Herring Wright-Patterson AFB, Ohio, AF Mater. Lab., Oct. 1964 187 p
(Contract AF 33(657)-8512)
(ML-TDR-64-321; AD-612052)

An experimental investigation was conducted to measure the gas–liquid solubilities for the helium–oxygen system at equilibrium conditions. The apparatus used was based on the vapor recirculation method of effecting equilibria and was constructed to operate at low temperatures and moderate pressures. Environmental conditions for the equilibrium cell were provided in a dewar-type cryostat with instrumentation for accurate temperature and pressure control in addition to the required communications for normal operation of an equilibrium apparatus. The system was studied in the temperature range 70° to 150° K and at pressures up to 200 atm with the data being obtained in isothermal form at 70°, 76°, 90°, 110°, 130°, 144°, and 150° K. Results are presented in both graphical and tabular form as mole percent of the minor component vs pressure with the raw data being analytically expressed in equation form to provide K-factor plots and cross-plots of composition vs temperature. Scatter in the data is within three percent for both phases with the more easily determined gas-phase data being somewhat more smooth. The analysis of compositions was made by gas chromatography utilizing two instruments to get maximum sensitivity for each component. By this method, the analytical accuracy was ±3% or better while temperature was controlled to ±0.02° K and pressure held constant to ±0.1% of the value stated. A thermodynamic analysis was made on the data to evaluate both the accuracy and self-consistency of the isotherms. Agreement with one previously determined isotherm for this system was within the estimated experimental accuracy.
Author

N65-19483# Brown Univ., Providence, R. I. Div. of Applied Mathematics
ON THE USE OF VARIATIONAL PRINCIPLES FOR THE SOLUTION OF LINEAR INITIAL-VALUE PROBLEMS Technical Report No. 96
Marshall J. Leitman and Morton E. Gurtin Dec. 1964 34 p refs
(Contract Nonr-562(10))
(C11-96; AD-611586)

Most boundary value problems of mathematical physics are completely characterized by variational principles which have been used with great success in obtaining approximate solutions. A method of deducing variational principles for linear initial value problems is given; in particular, variational principles are established for the problems associated with the heat and wave equations. The usefulness of these principles in generating sequences of approximate solutions is investigated. Two simple problems were chosen, one of heat conduction and one of wave propagation, and approximate results were compared, which arrived at by direct variational means, to the well-known exact solutions.
Author

N65-19509*# National Aeronautics and Space Administration, Washington, D. C.
INVESTIGATION OF THREE-DIMENSIONAL PHOTOELASTIC MODELS [K ISSLEDOVANIYU OB'YEMNYKH FOTOUPRUGIKH MODELEY]
Kh. K. Aben Mar. 1965 17 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 4, 1964 p 40–46
(NASA-TT-F-9290) CFSTI: HC $1.00/MF $0.50

General equations are derived for the photoelastic method. The transformation is made to a rotating coordinate system whose axes are alined with the quasi-principal stresses. The equivalence of the resultant equations to the Neumann equations is demonstrated, and the new equations are used to investigate certain special problems. General relations are derived for the method of characteristic directions, and the application of this method for the investigation of three-dimensional models is considered.
Author

N65-19560# RAND Corp., Santa Monica, Calif.
INVARIANT IMBEDDING AND TIME-DEPENDENT TRANSPORT PROCESSES—DIFFUSE REFLECTION WITH DELTA-FUNCTION INPUT
R. E. Bellman, H. H. Kagiwada, and R. E. Kalaba Dec. 1964 130 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4278-ARPA; AD-610609)

Recently developed numerical techniques are used to produce the reflection function for a variety of cases for a slab with isotropic scattering illuminated by flux of a delta-function nature in time. The computational results and Fortran programs are presented. Several checks on the results are discussed.
Author

N65-19561# RAND Corp., Santa Monica, Calif.
INVERSE PROBLEMS IN RADIATIVE TRANSFER: LAYERED MEDIA
R. E. Bellman, H. H. Kagiwada, R. E. Kalaba, and S. Ueno Dec. 1964 52 p refs
(Contract ARPA SD-79; ARPA Order 189-61)
(RM-4280-ARPA; AD-610621)

Consider a slab which consists of two layers which absorb and scatter light. First the basic differential-integral equation for the intensity of the diffusely reflected light is given, the source being uniform parallel rays. Then it is shown how to determine the nature of each layer using measurements of the light diffusely reflected from the slab. This is viewed as a nonlinear boundary-value problem and shown to be resolved computationally using the technique of quasi-linearization. Numerical examples and Fortran programs are provided. Author

N65-19601# Bausch and Lomb, Inc., Rochester, N. Y.
INFRARED COATING STUDIES Second Quarter Report, 18 Aug.–18 Nov. 1964
A. F. Turner, T. P. Martin, and L. Chang [1964] 25 p refs
(Contract DA-44-009-AMC-124(T))
(AD-609779)

Theoretical computations of the reststrahlen enhancement of four crystals—BaF_2, LiF, CaF_2, and SrF_2—are announced. The design analysis of the film combinations

$$[0.5L(H)0.5L]^m$$

and

$$0.33[Li(2H)1L]^m$$

has now been extended to show that with proper film indices the reflectance on the long wavelength side of the reststrahlen band may at the same time also be substantially reduced. Three-layer combination, five-layer combination, and missing order film combination are discussed. The extended short wavelength background of this missing order film combination, together with low long wavelength reflectances obtainable, make this enhancing coating the most attractive for experimental development despite the serious difficulties in finding the filming materials needed at the longer wavelengths. E.E.B.

N65-19751*# Midwest Research Inst., Kansas City, Mo.
RATIONAL APPROXIMATIONS TO THE RESPONSE OF A DYNAMIC SYSTEM DESCRIBED BY A NONLINEAR DIFFERENTIAL EQUATION Final Report, 15 Jan. 1964–14 Jan. 1965
Wyman Fair and Yudell L. Luke [1965] 18 p refs
(Contract NASr-63(07); MRI Proj. 2760-P)
(NASA-CR-57343) CFSTI: HC $1.00/MF $0.50

A linear fractional transformation is used to obtain rational approximations to the response of a physical system defined by a second-order nonlinear differential equation with constant coefficients. The initial approximations are constructed in the absence of damping, and then extended to include the case of a small damping term. The approximations are particularly effective in the case of slight damping and a large nonlinear restoring force. Author

N65-19786# Library of Congress, Washington, D. C. Aerospace Technology Div.
APPLICATION OF THE METHOD OF DEMODULATION ANALYSIS OF LIGHT TO SOME PROBLEMS IN TWO-BEAM INTERFEROMETRY [O PRIMENENII METODA DEMODULYATSIONNOGO ANALIZA SVETA K NEKOTORYM ZADACHAM DVUKHLUCHEVOY INTERFEROMETRII]
I. P. Mazan'ko 8 Mar. 1965 10 p refs Transl. into ENGLISH from Opt. i Spektroskopiya (Moscow), v. 17, no. 2, 1964 p 272–277
(ATD-T-65-8) CFSTI: HC $1.00/MF $0.50

The method of demodulation analysis is used, first, to analyze theoretically experiments designed to detect interference between two light beams with a large path difference and to indicate the basic feasibility of recording interference effects between the independently received signals; and second, to evaluate the problem of measuring the spectral width of laser emission. The correlation theory used ensures a uniform approach to problems of this type. Author

N65-19801# Sandia Corp., Albuquerque, N. Mex.
SOUND RAYS IN THE ATMOSPHERE
R. J. Thompson Jan. 1965 14 p refs
(SC-RR-64-1756)

In this report a system of ordinary differential equations governing ray paths in the presence of winds is derived under the assumption that the winds and the speed of sound depend only on altitude. The results are compared with several methods used for finding ray paths approximately. Author

N65-19838# Midwestern Universities Research Association, Madison, Wis.
MAGNETIC FIELD CALCULATIONS SUITABLE FOR A HEAVY LIQUID BUBBLE CHAMBER MAGNET
F. J. Kriegler and S. C. Snowdon 23 Feb. 1965 16 p refs Prepared under subcontract for Argonne Natl. Lab.
(MURA-708) CFSTI: $1.00

A simplified method of calculating two-dimensional magnetic fields, including the effects of finite permeability in the iron, is presented. The geometry chosen is that of an H magnet and is suitable for considerations of magnetic fields desired in connection with heavy liquid bubble chambers. Author

N65-19946# Atomic Energy Commission, Germantown, Md. Div. of Technical Information
A TABULATION OF THE DOPPLER INTEGRALS $\psi(x,t)$ AND $\phi(x,t)$
Kamal K. Seth (Northwestern Univ.) and R. H. Tabony (Duke Univ.) 28 Feb. 1964 29 p refs
(TID-21304) CFSTI: $2.00

The doppler integrals

$$\psi(x,t) = (4\pi t)^{-\frac{1}{2}} \int_{-\infty}^{\infty} [(1 + y^2)^{-1}] \exp[-(x - y)^2/4t]\, dy$$

and

$$\phi(x,t) = (4\pi t)^{-\frac{1}{2}} \int_{-\infty}^{\infty} [y(1 + y^2)^{-1}] \exp[-(x - y)^2/4t]\, dy$$

have been calculated over a wider range of arguments, $t = 0$ to 10000 and $x = 0$ to $20\sqrt{t}$ with an accuracy better than 0.2 percent. The results for $\psi(x,t)$ are compared with other calculations, both published and unpublished, and errors in the old calculations are brought to notice. Author

N65-19954# Naval Air Development Center, Johnsville, Pa. Anti-Submarine Warfare Lab.
RELAXATION TIME AND POLARIZATION MEASUREMENTS WITH THE RUBIDIUM ABSORPTION CELL
H. B. Perkins and B. R. Grunstra 9 Dec. 1964 39 p refs
(NADC-AW-6422; AD-453888)

A method of measuring the longitudinal relaxation of Rb vapor contained in an absorption cell irradiated by polarized resonance radiation is discussed in connection with the resultant current wave shape of the optical detection system as a function of photomultiplier saturation and the mechanical shutter transit time. Certain aspects of optical pumping efficiency are also discussed in terms of the ellipticity of the resonance radiation. A method to determine the difference in phase of the ordinary and extraordinary wave produced by the quarter-wave plate of a circular polarizer as a function of incident radiation wave length is described and the results using an 8200 A quarter-wave plate for the D_1 line of Rb are given. Author

N65-20057# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
THE ANGULAR EFFECTS DUE TO ASYMMETRIC PLACEMENT OF AXIALLY SYMMETRIC EXPLOSIVES
T. Teichmann 26 Oct. 1964 9 p
(Contract AF 29(601)-6214)
(GAMD-5823; AD-453906)

In considering the gross mechanical effects of shaped explosives (i.e., the overall motion of the target) it is necessary to know both the total effective linear momentum as well as the total effective angular momentum imparted to the target. In many, if not most, cases of practical interest, the configuration of both the charge and the target are cylindrically symmetrical, and in the ideal circumstances there is no angular momentum. In such cases, however, it is important to determine the angular forces induced by small variations in the position of the charge from the symmetric configuration. A calculation of the first-order terms of this kind is given. Author

N65-20065# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
THE ACOUSTICS OF SOLID PROPELLANT COMBUSTION INSTABILITY
31 Aug. 1964 7 p refs
(Contract DA-19-020-AMC-5755-R)
(QTPR-7; AD-459425)

A simple technique has been developed for estimating the limiting amplitude of oscillation. This is based on the fact that in the Fourier series representation of a function with a discontinuity, the amplitude of the n^{th} harmonic decreases as 1/n relative to the fundamental. Applying this technique to T-burner experiments in solid propellant combustion requires specifying the real and imaginary parts of the acoustic admittance of the propellant for the first three modes. By making crude guesses about these admittances based on data for the first two modes, values of limiting pressure have been calculated which differ from actual values by factors of from 1 to about 1/30. A crude analysis of possible transition in an acoustic boundary layer is presented, to analyze the possible effect on increased boundary layer and erosion losses in T-burners. E.P.V.

N65-20079# Lockheed Missiles and Space Co., Sunnyvale, Calif.
THE HAKENMETHODE A Review Article
W. C. Marlow [1964] 37 p refs
(LMSC-A034392)

A review is presented which describes a basic experimental arrangment for the formation of hooks and introduces the important experimental parameters involved in an f-value measurement by the hakenmethode. The general theory of the technique and its application to single and multiple line spectra and spectral lines whose absorption widths may be an appreciable fraction of the interference hook separations are described and the significance of the complex refractive index and absorptivity of a dispersive and dissipative medium is discussed. S.C.W.

N65-20088# France. Office National d'Etudes et de Recherches Aerospatiales, Chatillon-sous-Bagneux.
RESULTS ON THE NUCLEAR INDUCTION GYROMETER [RESULTATS SUR LE GYROMETRE A INDUCTION NUCLEAIRE]
Guy Hanuise 1964 11 p refs In FRENCH Presented at Colloq. sur les Gyroscopes Avances, Paris, 2–6 Nov. 1964
(TP-185(1964))

The use of a magnetic resonance magnetometer as a gyroscope is described. The theoretical basis for such an application is developed, showing that the slope of the beginning of the curve of the signal as a function of a transverse field is proportional to the relaxation time. Experimental results obtained demonstrate the validity of the theory, and experiments are in progress to verify the equivalents of a magnetic field and of a rotation. M.P.G.

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N65-18646# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE PROBLEM OF TRANSVERSE INSTABILITY OF CHARGED BEAMS IN STORAGE SYSTEMS
V. G. Grishin 11 Jun. 1963 7 p refs Transl. into ENGLISH from Vestn. Mosk. Univ. (Moscow), no. 6, 1962 p 83–85
(FTD-TT-63-530/1+2+4; AD-413662)

Transverse effects of a space charge in cyclic systems were examined. For simplicity, a beam in which the particles performed nonlinear oscillations with the same energy was assumed. The field of the formed positive density fluctuations accelerates the particles moving in front of the fluctuations, and slows down the particles moving behind it. If the oscillation frequency decreases with an increase of energy, the density fluctuations increase; if the oscillation frequency increases with an increase of energy, the density fluctuations decrease. Specific cases are developed to determine radial motion, and the distribution function for the state of the beam. E.E.B.

N65-18658# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANGULAR LAWS OF DISPERSION AND ION-ELECTRON EMISSION AT GREATER ION TARGET INCIDENCE ANGLES
Ye. S. Mashkova and V. A. Molchanov 7 Jan. 1965 5 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 11, 1964 p 81–82
(FTD-TT-65-9/1+2; AD-610416)

Angular dispersion and ion-electron emission was determined for ion target incidence angles from 60° to 86° with a

measurement accuracy of ±7%. Polycrystalline copper, tungsten, nickel, and molybdenum were used as target materials. Nickel and tungsten targets were bombarded with argon ions of 30-keV energy. For copper and molybdenum, emission coefficients were measured at 30-keV energy, and the dispersion coefficients were measured at 27.5-keV energy. It was observed that the angular dependences of dispersion and emission coefficients differ sharply. Coefficient curves gave no maxima for emission whereas the dispersion curves give a definite maxima. The explanation given is that the curves of angular dependence of dispersion coefficients are connected with displaced atoms of the lattice, which do not participate in the secondary electron formation process. E.E.B.

N65-18667# Princeton Univ., N. J. Dept. of Aeronautical Engineering
ELECTRON-HEAVY-PARTICLE NONEQUILIBRIUM IN AN ARGON ARCJET Interim Documentary Report
Martin P. Sherman, Paul F. Jacobs, and Jerry Grey Wright-Patterson AFB, Ohio, ARL, Oct. 1964 39 p refs *Its* Rept. No. 645
(Contract AF 33(657)-9962)
(ARL-64-210; AD-610530)

The departure from equilibrium in a dense, partly ionized arc jet exhaust is estimated in terms of the mole fractions of the various constituents, the electron-heavy particle temperature difference, and the populations of excited states. Cooling of the arc jet is accomplished by mixing with a different cool gas; the example studied is that of a hot subsonic argon jet mixing with cool helium at one atmosphere, using measured time rates of temperature decay. The energy-exchange processes considered are elastic collisions, radiation, and the various types of ion–electron recombination. It is concluded that the electron-heavy particle temperature difference is small when the temperature decay rate is small (i.e., slow mixing), but can be of the order of 20% of the heavy-particle temperature at the highest temperature decay rates observed experimentally. In the latter case, therefore, it cannot be assumed that the arc jet exhaust is in equilibrium. Author

N65-18790# Brookhaven National Lab., Upton, N. Y. Sigma Center
NEUTRON CROSS SECTION EVALUATION GROUP. ANALYSIS OF (n, 2n) CROSS SECTIONS FOR NUCLEI OF MASS A > 30
S. Pearlstein Dec. 1964 50 p refs
(BNL-897(T-365)) CFSTI: $3.00

The ability of the statistical model of nuclear reactions to interpret measured (n, 2n) cross sections was tested. Good agreement was observed for 22 nuclei having mass numbers greater than 30. The statistical model was then applied to all nuclei in this mass range to estimate both monoenergetic and fission spectrum averaged cross sections. Author

N65-18906# Iowa State Univ. of Science and Technology, Ames. Ames Lab.
ANGULAR CORRELATION OF ANNIHILATION GAMMA RAYS AND CRYSTAL ORIENTATION
Roger Lee Bredeweg and D. J. Zaffarano Nov. 1964 47 p refs
(Contract W-7405-ENG-82)
(IS-1024) CFSTI: $2.00

A correlation between the direction in which the annihilation gamma rays are emitted, and the shape of the Fermi surface is investigated in single crystals of beryllium, lead, tin, and sodium tungsten bronze. A fast–slow coincidence technique is used. The results do not indicate a correlation between the shape of the Fermi surface and the direction of the emitted gamma rays. Author

N65-18918*# Princeton Univ. Observatory, N. J.
HYDROGEN MOLECULES AND ASTRONOMY: A REVIEW
W. B. Somerville, G. B. Field, and K. Dressler Jan. 1965 90 p refs
(Grant NsG-414)
(NASA-CR-57156) CFSTI: HC $3.00/MF $0.75

Discussed are the following topics: *The Theory of the Hydrogen Molecule*—formulation, nuclear vibration and rotation, the calculation of electronic wave functions, electronic states, the coupling of angular momentum vectors, symmetry, transitions, correction terms to the energy, and the molecular ion H_2^+; *Hydrogen Molecules in Astrophysics*—general considerations, planetary and stellar atmospheres, and interstellar space; *Spectroscopically Determined Term Values and Transistions in H_2*—the language of molecular spectroscopists, the rotational and vibrational structure of the ground state, and excited states and electronic transitions. G.G.

N65-19044# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
KINEMATICS OF MULTIPARTICLE REACTIONS
C. Zupancic Jun. 1964 22 p refs
(NIJS-R-429)

This guide presents examples of how to solve problems in kinematics of low-energy nuclear physics. The consequences of momentum and energy conservation, and Galilean invariance for nonrelativistic kinematics are discussed and its phase-space predictions for cross sections are derived. A relativistic version of the material is also presented. G.G.

N65-19146# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SPECTRUM OF GAMMA-RADIATION AND PARTIAL VALUES OF ABSORBED ENERGY IN AN ARBITRARY HOMOGENEOUS MIXTURE
V. A. El'tekov, B. M. Terent'yev, and M. V. Panchvidze 3 Feb. 1965 13 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 16, no. 4, 1964 p 291–295
(FTD-TT-65-79/1+2; AD-611010)

Gamma radiation spectra and the distribution of absorbed gamma energy in a homogeneous medium are discussed. Also calculations for indium–gallium and water for energies, E_0 = 1.085 MeV and E_0 = 0.406 MeV gave close agreement between the Monte Carlo method and calculation by using integral equations. E.E.B.

N65-19207# American Science and Engineering, Inc., Cambridge, Mass.
A RESEARCH PROGRAM TO INVESTIGATE ARTIFICIALLY INJECTED TRAPPED RADIATION Final Report
R. Giacconi, F. R. Paolini, W. C. Hadley, and R. Talbot, Jr. 30 Oct. 1964 155 p refs
(Contract AF 19(628)-2799)
(ASE-759; AFCRL-64-917; AD-611629)

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2. PROTON-ALPHA EXPERIMENT G. Davidson, R. Giacconi, H. Gursky et al p 37–122 (See N65-19209 09-24)

3. MEASUREMENTS ON TRAPPED PARTICLES INJECTED BY NUCLEAR DETONATIONS L. Katz, D. Smart, F. R. Paolini, R. Giacconi, and R. J. Talbot, Jr. p 123–145 refs (See N65-19210 09-24)

N65-19208 American Science and Engineering, Inc., Cambridge, Mass.
PROTON SPECTROMETER
G. Davidson, R. Giacconi, H. Gursky et al *In its* A Res. Program to Investigate Artificially Injected Trapped Radiation 30 Oct. 1964 p 21–36 Excerpt from a Res. Program to Investigate the Exptl. Probl. of Particle Meas. in Space 27 May 1963 p 133–146 (See N65-19207 09-24)
(Contract AF 19(604)-7347)
(ASE-400)

An instrument designed, constructed, and flown primarily for the purpose of measuring the energy spectrum of protons in the energy region of 6 to 100 MeV in the heart of the Van Allen belt is described. The spectrometer is directional within a cone of ±5° from its axis, and therefore is capable of yielding information on pitch angle distributions. The detector consists of a thallium-activated cesium iodide crystal whose thickness is equivalent to the range of 90 MeV protons. Protons of energy greater than 6 MeV and smaller than 90 MeV enter the crystal and are stopped by it. The crystal therefore has a response proportional to the total energy of the proton. Protons of energy less than 6 MeV are filtered by an aluminum shield whose thickness is equivalent to the range of 6 MeV protons. Detailed description of the apparatus and calibration procedures are included. E.E.B.

N65-19209 American Science and Engineering, Inc., Cambridge, Mass.
PROTON-ALPHA EXPERIMENT
G. Davidson, R. Giacconi, H. Gursky et al *In its* A Res. Program to Investigate Artificially Injected Trapped Radiation 30 Oct. 1964 p 37–122 Excerpt from a Res. Program to Investigate the Exptl. Probl. of Particle Meas. in Space 27 May 1963 p 58–89 (See N65-19207 09-24)
(Contract AF 19(604)-7347)
(ASE-400)

Instrumentation designed to detect protons, alpha particles, and other heavy particles in the energy range of interest; to distinguish between these particles; and to measure the energy spectrum of particles detected is discussed. Scintillation counter systems were chosen to accomplish the three basic measurements. Detailed information on the counter system, electronic circuitry, and calibration, and operational procedures are included. E.E.B.

N65-19210 American Science and Engineering, Inc., Cambridge, Mass.
MEASUREMENTS ON TRAPPED PARTICLES INJECTED BY NUCLEAR DETONATIONS
L. Katz, D. Smart, F. R. Paolini, R. Giacconi, and R. J. Talbot, Jr. *In its* A Res. Program to Investigate Artificially Injected Trapped Radiation 30 Oct. 1964 p 123–145 refs Repr. from Space Res. IV Presented at the 4th Intern. Space Sci. Symp., Warsaw, 3–12 Jun. 1963 Prepared Jointly with AFCRL (See N65-19207 09-24)

A polar-orbiting satellite carried aloft a payload, shared by many experimenters, of radiation detection instruments for studying artificially produced trapped-radiation belts. Pertinent information on the satellite's orbit and capabilities is given. Data from four scintillation detectors are presented. The detectors have capabilities for discriminating among types of particles, and for measuring both energy and angular distributions of trapped particles. Data showing spatial distributions of trapped radiation, both as omnidirectional flux versus L-shell plots and as isointensity contour plots, are presented. The major portion of data presented emphasizes electron pitch angle distributions and derived parameters. Both spatial and temporal variations of the pitch angle distributions (measured with a 6° angular resolution) are given. Some tentative conclusions are drawn. Author

N65-19244# New Mexico Univ., Albuquerque. Bureau of Engineering Research
RESEARCH, LABORATORY TESTING AND THEORETICAL STUDIES SUPPORTING AFWL TREES PROGRAM Technical Report, Apr. 13, 1963–Aug. 17, 1964
W. W. Grannemann, Harold Southward, William J. Byatt et al Kirtland AFB, N. Mex., AF Weapons Lab., Jan. 1965 233 p refs
(Contract AF 29(601)-5976; ARPA Order 307-62)
(WL-TR-64-123; AD-610759)

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4. MEASUREMENT OF THE CONTINUOUS SPECTRUM OF A FLASH X-RAY MACHINE H. Southward p 71–92 (See N65-19248 09-24)

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13. DIRECTIONAL RADIATION STUDY G. Davis and W. W. Grannemann p 209–212 (See N65-19254 09-09)

N65-19245 New Mexico Univ., Albuquerque. Bureau of Engineering Research
TRANSIENT GAMMA RADIATION EFFECTS ON RESISTIVE AND INSULATING MATERIALS
William J. Byatt and Harold Cates *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 1–34 (See N65-19244 09-24)

Irradiation of carbon resistors with X-radiation has shown that the value of resistance decreases with dose rate, and the percentage change in rates resistance value depends critically on the original value of the resistance. It was concluded that the decrease in resistance caused by the radiation was due entirely to air ionization effects. Therefore, potting of resistors, which leads to a decrease in these effects, can reduce the radiation effects on resistors. E.E.B.

N65-19246 New Mexico Univ., Albuquerque. Bureau of Engineering Research

TRANSIENT RADIATION EFFECTS ON HALL DEVICES

W. W. Grannemann, Harold Cates, and Le Roy Meyer *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 35–46 (See N65-19244 09-24)

The Hall devices were found, by experiments with the flash X-ray and gamma Linac, radiation resistant for dose rates up to 10^8 R/sec. Theoretical calculations indicate a radiation resistance up to at least 10^9 R/sec. These results were obtained using the constant current circuit configuration. Theoretical calculations for the constant voltage circuits indicate no change in Hall voltage for n-type material. At dose rates above 10^9 both holes and electrons become involved and the Hall voltage equation becomes more complicated. A transient radiation effect is predicted at the higher dose rates. Higher dose rate machines are needed to check the theory at the higher dose rates. Author

N65-19248 New Mexico Univ., Albuquerque. Bureau of Engineering Research

MEASUREMENT OF THE CONTINUOUS SPECTRUM OF A FLASH X-RAY MACHINE

Harold Southward *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 71–92 (See N65-19244 09-24)

A method for measurement of the continuous spectrum of a flash X-ray machine, limited to situations in which the shape of the X-ray pulse is closely reproducible, is described. The method is limited to spectral measurements at energies below the threshold for pair production. The maximum photon energies contained in the distribution, therefore determine the type of material used as an attenuator. E.E.B.

N65-19249 New Mexico Univ., Albuquerque. Bureau of Engineering Research

GAMMA RADIATION EFFECTS ON DIELECTRIC MATERIALS

LeRoy Meyer and W. W. Grannemann *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 93–156 (See N65-19244 09-24)

Insulator characteristics are reviewed to give a basic understanding of radiation effects. The largest bulk effect was radiation-induced conductivity. Air ionization is a significant effect around high impedance components in a circuit exposed to air. The Hall effect method and the magnetoresistance method were developed to measure the mobility of polymeric materials. A value of 10^{-3} cm^2/V-sec was observed for polyethylene and slightly less for mylar. The maximum air ionization effect was found to be at a pressure of 150 mm Hg. The radiation-induced conductivity in air increased with decreasing pressure to about 150 mm Hg, and then decreased until the pressure was about 10 microns. It remained constant at pressures below this value. A similar result was found for resistors. A guard ring on film capacitors was found to reduce the air ionization effect at atmospheric pressure to approximately that of 10 microns Hg. E.E.B.

N65-19251 New Mexico Univ., Albuquerque. Bureau of Engineering Research

A MONTE CARLO CODE FOR TRANSIENT RADIATION EFFECTS

William J. Byatt and Dale Sparks *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 163–182 (See N65-19244 09-24)

A Monte Carlo code, constructed for the calculation of transient radiation effects, is reported. The code will determine the time spreading of the prompt gamma-ray pulse from a nuclear explosion, and the number of free electrons generated by the prompt pulse. The time spreading is of interest because the transient radiation effects are dose-rate dependent, and the free electrons contribute to changes in conductivity. The code is described, and two problems to which the code has been applied are discussed. E.E.B.

N65-19253 New Mexico Univ., Albuquerque. Bureau of Engineering Research

CABLE STUDY

Arthur Golubiewski and W. W. Grannemann *In its* Res., Lab. Testing and Theoret. Studies Supporting AFWL Trees Program Jan. 1965 p 199–208 (See N65-19244 09-24)

A mathematical model is proposed for the determination of flash X-ray effects on a coaxial cable whose electrical length is long compared to the duration of the pulse. The mode relates the expected output pulse to the gamma-induced photoconductivity. Because of the high level of pulser generated rf noise pickup in the cable, gamma-induced effects could not be determined in a test with 72 1/2 feet of coaxial cable. E.E.B.

N65-19262*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science

DEVELOPMENT OF NEUTRON ACTIVATION ANALYSIS PROCEDURES FOR THE DETERMINATION OF OXYGEN IN POTASSIUM Final Report, Period Ending 15 Dec. 1964

E. L. Steele, H. R. Lukens, Jr., and V. P. Guinn [1964] 52 p refs (Contract NAS3-2537)

(NASA-CR-54100; GA-5982) CFSTI: HC $3.00/MF $0.50

An analytical method for the rapid determination of oxygen in potassium by neutron activation is reported. The procedures described have a practical lower detection limit of 25μg of oxygen for a single determination. The practical maximum sample volume is about 8 cc or approximately 7 grams of potassium. At the 25 μg oxygen level, this corresponds to an oxygen concentration of 3.5 ppm. At the 1-ppm oxygen level, the uncertainty is estimated to be $\pm$0.7 ppm. The most sensitive detection system for N^{16} at the present time is one employing two large NaI(Tl) crystals. E.E.B.

N65-19263*# General Electric Co., Pleasanton, Calif.

RESEARCH PROGRAM FOR THE LONG TERM TESTING OF CYLINDRICAL DIODES AND THE IRRADIATION OF FUEL AND INSULATOR Fifth Quarterly Summary Report

S. H. Shepard 17 Sep. 1964 58 p refs (Contract NAS3-2544)

(NASA-CR-54267; GEST-2039) CFSTI: HC $3.00/MF $0.50

The out-of-pile testing of converter 301 was terminated because of filament failure after 3754 hours of operation at 7.2 W/sq cm^2. Failure of converters 302 and 303 was due to leaks in the tantalum thimble. Also, localized distortion in the tungsten emitter due to impurities was found in converter 303. Out-of-pile converters 311 and 312 have operated for 2298 and 1676 hours, respectively. Thermal and stress analyses were

initiated to determine cell temperature distributions for representative cells of a thermionic fuel element. Assembly and detail drawings were partially completed for the out-of-pile converters, fueled with UO_2 and clad with W-26% Re. E.E.B.

N65-19325# Naval Air Development Center, Johnsville, Pa. Anti-Submarine Warfare Lab.
DEEXCITATION OF HELIUM ATOMS IN THE METASTABLE TRIPLET STATE (2^3S) IN PURE HELIUM
F. K. Elder, Jr. and William F. Wintzer 23 Dec. 1964 57 p refs
(NADC-AW-6428; AD-609832)

The processes whereby the functioning of a metastable helium magnetometer may be deteriorated or destroyed by deexcitation of metastable triplet atoms are discussed, with particular attention to processes that take place even in very pure helium. Topics treated include relative effectiveness of destruction processes, species of colliding particles and types of collisions, and effects of cell dimensions and pressure on metastable destruction. A bibliography of the unclassified periodical literature arranged alphabetically by author is included, giving titles and abstracts of articles, to provide a concise but relatively complete survey of the field. Author

N65-19342# Istituto Superiore di Sanita, Rome (Italy). Laboratori di Fisica
AN APPARATUS FOR CALIBRATION OF RADIOACTIVE SOURCES BY MEANS OF A $4\pi\beta$-γMETHOD [UN APPARATO PER LA CALIBRAZIONE DI SORGENTI RADIOATTIVE CON IL METODO DELLE COINCIDENZE $4\pi\beta$-γ]
A. Grisanti and P. Tori 12 Nov. 1964 43 p refs In ITALIAN; ENGLISH summary
(ISS-64/37)

An apparatus is described for calibration of β-γ emitters by means of a $4\pi\beta$-γ coincidence method. The processes used for testing such an apparatus and the necessary formulas for treating the experimental data are also illustrated. Author

N65-19364# Army Materials Research Agency, Watertown, Mass. Materials Research Div.
VIBRATIONAL LEVELS IN LIQUID BROMINE BY NEUTRON INELASTIC SCATTERING
John J. Antal and M. Antonini Oct. 1964 23 p refs
(AMRA-TR-64-32; AD-609678) CFSTI: $0.50

The first and second vibrational levels of the Br–Br molecule were measured directly for the first time in the liquid state. The beryllium filter technique of neutron inelastic scattering was employed to excite the vibrational levels and measure their energy. Low intensities of scattered neutrons were encountered because of the large mass of the bromine atom, and a special correction technique had to be deivsed to remove the effect of the quartz container necessary to hold this reactive liquid. The bromine molecule appears to retain its individuality in the liquid state as evidenced by the close agreement of the vibrational energy values found in this experiment (0.0401 eV and 0.0836 eV) with those found by others from infrared studies on the gaseous state. Author

N65-19383# Columbia Univ., New York. Plasma Lab.
TRANSPORT PROPERTIES OF HYDROGEN
Dieter Brezing Sep. 1964 72 p refs
(Contract AF 49(638)-1254)
(Rept.-13; AD-609345)

The transport properties of hydrogen are calculated for a pressure range from 10^{-6} to 10^{2} atm, and at temperatures up to 10^{5}° K. The lower temperature limit is taken where the equilibrium gas mixture contains less than 1% molecular hydrogen. The Boltzmann formalism, which assumes binary collisions in the expressions for the transport properties of gas mixtures, is applied. Theoretical values, supported by experimental data whenever possible are used for the atom–atom, atom–ion, and atom–electron collision cross sections. For Coulomb force interactions between charged particles, the Debye length is used as cutoff distance. The collision integrals for all interactions are computed. Values of viscosity, thermal, and electrical transport coefficients, as well as the thermoelectric coefficients are calculated. Author

N65-19394# Nihon Univ., Tokyo (Japan). Dept. of Physics
POSSIBLE CHOICE OF FUNDAMENTAL PARTICLE MODELS
Shin Ishida [1964] 7 p refs
(NUP-65-1)

The triplet model and the quartet model of mass splitting are evaluated using the baryon octet as an example. The results obtained using each model are compared to actual experimental data, and the triplet model is shown to be preferable as a fundamental particle model within the scheme of SU(3) symmetry. M.P.G.

N65-19395# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
THE nn SCATTERING LENGTH
Hyman Goldberg Jan. 1965 20 p refs
(Th-85)

The contribution of the $\pi^{\pm}$ π^{0} mass diffarance to the difference in the $^1S_0$ np and nn scattering lengths is calculated by a method due to Dashen and Frautschi. In the calculation only the one pion exchange contribution is retained and difference $a_{nn} - a_{np} = -4.80F$ is obtained. The deviation of the coupling constants is also estimated, and this is shown to give negligible contribution to the difference. Author

N65-19396# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
3-PARTICLE NON RELATIVISTIC KINEMATICS AND PHASE-SPACE
Jean-Marc Lévy-Leblond and Monique Lévy-Nahas Jan. 1965 16 p refs
(TH-83)

The kinematics of a nonrelativistic three-particle system is studied. Basis states are constructed which are eigenstates, in addition to the total momentum-energy, angular momentum, etc., of new observables; among these, the togetherness tensor describes the simultaneous localization of the three particles and therefore is of great physical interest. All of these observables arise as Casimir operators of a great group acting on the three-particle phase-space manifold in a transitive way, and of some of its subgroups. In the present case, by trying to keep all the particles on the same footing ("democracy" arguments), the SU_3 group is chosen as a particularly convenient great group. The Dragt classification of nonrelativistic three-particles states are recovered. The explicit calculation of the basis functions is done in a new way, by analytical methods, solving partial derivative equations. This enables us to establish the most general form of these basis functions. Author

N65-19398# Nihon Univ. Tokyo (Japan). Coll. of Science and Engineering
MASS SPLITTING OF MESONS AND BARYONS AND COMPOSITE MODEL
Shin Ishida Feb. 1965 20 p refs
(NUP-65-2)

Mass splitting of mesons and baryons, both interunitary multiplets and interisomultiplets, is discussed by assuming that the origin of the breakdown of SU(3)-symmetry is due to the existence of small mass differences among the fundamental triplet, of which all particles are composed. Besides the well-known formulas derived under the general assumption of the transformation property of the symmetry-breaking Hamiltonian in unitary space, many new mass formulas are derived which are fairly good experimentally. Author

N65-19449 Illinois Univ., Urbana. Engineering Experiment Station
BACKSCATTERING FOR GAMMA RAYS FROM A POINT SOURCE NEAR A CONCRETE PLANE SURFACE
Arthur B. Chilton Nov. 1964 93 p refs *Its* Bull. 471, Vol. 62, No. 36
(Contract OCD-OS-63-66) Available from Illinois Univ.: $1.50

Backscattering factors, as fractions of a direct dose rate in a vacuum, are obtained for point sources of gamma radiation, specifically cesium-137 and cobalt-60, placed near a plane interface between vacuum and concrete. The method derived is based on application of albedo principles, using the Chilton–Huddleston formulation for albedo. The results are considered applicable to air–concrete or air–ground interface situations, provided the distances of source to detector, source to interface, and detector to interface are greater than a mean free path of the source gamma radiation in the concrete or ground but substantially less than that in air. The basic methodology relates to infinite planes; however, factors for correcting these values for certain finite plane cases are derived. Limited experimental data are available and are compared with these calculations. The techniques for making the calculations for the specific radioisotopes indicated are generally applicable to any monoenergetic or mixed-energy source having photons within the energy range from 0.2 MeV to several MeV. Author

N65-19459# Phillips Petroleum Co., Idaho Falls, Idaho. Atomic Energy Div.
SLOW NEUTRON INELASTIC SCATTERING FROM LOW TEMPERATURE GASEOUS METHANE, LIQUID METHANE AND SOLID METHANE
Y. D. Harker and R. M. Brugger Feb. 1965 34 p refs
(Contract AT(10-1)-205)
(IDO-17044) CFSTI: $2.00

The partial differential cross sections for inelastic scattering of neutrons from samples of cold gaseous methane (T = 125° K), liquid methane (T = 99° K), and solid methane (T = 83° K) were measured with the Materials Testing Reactor (MTR) phased chopper velocity selector. These results are compared to the theory reported by Griffing for methane gas; the results of these comparisons indicate that the rotations are free in all three phases and that in the liquid and solid phases there are oscillations of the center of mass of the molecule with dominant transitions having an energy change near 0.017 eV. The range of agreement of the gas theory with the liquid and solid data indicates that the liquid and solid act according to the gas model out to times the order of 5×10^{-13} sec. The similarity of the liquid and solid data over the range of the experiment suggests further that they act similarly out to even longer times. Author

N65-19537# Oak Ridge National Lab., Tenn. Neutron Physics Div.
DETERMINATION OF THERMAL-NEUTRON FLUX DISTRIBUTIONS IN THE BULK SHIELDING REACTOR II BY COPPER WIRE ACTIVATION TECHNIQUES
G. T. Chapman Mar. 1965 55 p refs
(Contract W-7405-ENG-26)
(ORNL-3759) CFSTI: $3.00

The thermal-neutron flux distribution was determined by exposing copper wires at selected locations in the core during reactor operation. The gamma-ray activity resulting from thermal-neutron activation of the copper was counted as a function of position along the wire, and the results were converted to estimates of thermal-neutron flux by the methods described in this report. The method of analysis was checked by independently exposing gold and copper wires at a common location in the reactor. The thermal-neutron fluxes obtained from analysis of both sets of data were in agreement within ~3%. The method was further checked by comparing the results of a wire exposure with calculations of the distribution made by the PDQ reactor code. Agreement was good in statistically important regions. Author

N65-19542# IIT Research Inst., Chicago, Ill. Technology Center
STUDIES OF THE RESONANCE INTEGRALS OF Re AND Tm Final Report, Mar. 15, 1963–Mar. 14, 1964
G. Hardie, D. A. Klopp, W. E. Loewe, and W. E. Zagotta Washington, AEC, 30 Sep. 1964 120 p refs
(Contract AT(11-1)-578)
(IITRI-578P24-12) CFSTI: $4.00

A three-phase program measured the resonance integral of thulium by activation and reactivity techniques, calculated the effect of crystalline binding on the infinitely dilute resonance integral of rhenium and measured the sensitivity of the reactor for danger coefficient measurements. The quasi-absolute counting technique yielded 1110 ± 130 barns, the cadmium ratio, 2210 ± 160 barns, and the danger coefficient, 1790 ± 200 barns. An additional value of 1600 ± 500 barns was obtained by calculation using the resonance parameters. It is concluded that this package of measurements has evinced errors which would not have otherwise been discovered and which are probably systematic errors. Author

N65-19545# Oak Ridge National Lab., Tenn. Neutron Physics Div.
NUCLEON-MESON CASCADE CALCULATIONS: TRANSVERSE SHIELDING FOR A 45-GeV ELECTRON ACCELERATOR (PART IV)
R. G. Alsmiller, Jr., F. S. Alsmiller, and J. Barish Mar. 1965 17 p refs
(Contract W-7405-ENG-26)
(ORNL-3734) CFSTI: $1.00

In previous reports nucleon–meson cascade calculations were described for several cases of interest in the design of the transverse shield for a proposed 45-GeV linear electron accelerator. This report describes a recalculation with an improved IBM code of one of the cases previously treated. There are numerical differences between the present and previous results but the total dose estimates obtained from the two calculations are essentially the same. Author

N65-19558# Brookhaven National Lab., Upton, N. Y. Sigma Center
OPTICAL MODEL ANALYSIS OF THE NEUTRON-SODIUM CROSS SECTION IN THE 1–4 MeV RANGE

T. J. Krieger and S. Pearlstein Feb. 1965 8 p refs *Its* Newsletter No. 8, Jan. 1965
(BNL-904(N-8)) CFSTI: $1.00

An optical model for calculation of sodium cross sections was presented. A local optical model potential was chosen, and least-squares estimates of its parameters were derived to fit experimental values for neutron differential elastic scattering and total cross section in sodium-23 in the 1 to 4 MeV range. Observed and theoretical values are given, which indicate good performance by the model. J.M.D.

N65-19568# American Meteorological Society, Boston, Mass.
THEORY OF THE PASSAGE OF FAST CORPUSCULAR RAYS THROUGH MATTER [ZUR THEORIE DES DURCHGANGS SCHNELLER KORPUSKULARSTRAHLEN DURCH MATERIE]
H. Bethe Bedford, Mass., AFCRL, Sep. 1964 77 p refs Transl. into ENGLISH from Ann. Physik (Leipzig), Ser. 5, no. 5, 1930 p 325–400 Revised
(Contract AF 19(628)-3880)
(T-G-142; AD-453044)

The inelastic collision of a fast charged particle with an atom is treated according to Born's theory of wave mechanics. A very simple procedure is given for evaluating the matrix elements involved in the theory, and the close relationship to the intensity of the Compton effect is determined. The theory is developed in detail for collisions of hydrogen atoms and, as far as possible, for complex atoms. The following are computed: the angular distribution of the inelastically and elastically scattered particles, the excitation cross sections for the excitation of the optical and X-ray levels by electron collision, the sum of all inelastic and elastic collisions, and also the number of the primarily and secondarily formed ions, the velocity distribution of the secondary electrons and, finally, the braking of the colliding particles by gas atoms. The agreement of this theory with experiment is satisfactory to good.
Author

N65-19662# Boeing Scientific Research Labs., Seattle, Wash. Flight Sciences Lab.
ELECTRON RETARDING POTENTIAL MEASUREMENTS ON CO_2, N_2O AND NO_2 Flight Sciences Lab. Report No. 93
Richard I. Schoen Feb. 1965 33 p refs
(DI-82-0406)

Electron retarding potential curves were obtained from the gases CO_2, N_2O and NO_2 from which estimates were made of several appearance potentials which lie in the ionization continua of each of the gases. Evidence is present in the cases of CO_2 of autoionization and in the cases of NO_2 and N_2O of dissociative ionization. Refinement of the method to the point at which clear evidence of vibrational excitation can be seen is needed. Author

N65-19663# Los Alamos Scientific Lab., N. Mex.
STATUS OF THE LASL MONTE CARLO INTRANUCLEAR CASCADE CALCULATION (1964)
S. L. Whetstone 3 Mar. 1965 30 p refs Presented at the Gordon Res. Conf. on Nucl. Chemistry, 23 Jun. 1964
(Contract W-7405-ENG-36)
(LA-3206-MS) CFSTI: $2.00

Changes in the original version of the Monte Carlo intranuclear cascade calculation include improved pion-production dynamics and the introduction of a Fermi-type nonuniform nuclear density distribution. A few intercomparisons between the results of the present and the original version are made. Some comparisons are also given between the present calculations and experiment. Author

N65-19679# Royal Astronomical Society, London (England).
MEMOIRS OF THE ROYAL ASTRONOMICAL SOCIETY, VOLUME 69, PART I: TABLES OF HYDROGENIC PHOTOIONIZATION CROSS-SECTIONS AND RECOMBINATION COEFFICIENTS
A. Burgess (London Univ.) 1964 23 p refs
(Contracts DA-30-69-ORD-2581; Nonr-285(49))

The cross sections for photoionization of a hydrogenic atom or ion initially in the state nl are tabulated to five significant figures for $n = 1(1)20$, $l = 0(1)n - 1$ and a wide range of energies of the ejected electron. The hydrogenic radiative recombination coefficents for a Maxwellian distribution of electron velocities are tabulated to four significant figures for $n = 1(1)20$, $l = 0(1)n - 1$ and electron temperatures $T = 0$ to ∞.
Author

N65-19701*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
MEASUREMENT OF NEUTRON SPECTRA IN LIQUID HYDROGEN Final Report
G. D. Trimble, G. K. Houghton, and J. H. Audas 30 Sep. 1964 237 p refs
(Contract NAS3-4214)
(NASA-CR-54230; GA-5750) CFSTI: HC $6.00/MF $1.25

Differential fast neutron spectra are presented for the neutron energy range 0.5 to 15 MeV in both water and liquid hydrogen as a function of space and angle. Measurements were made for 13.0, 10.5, 7.0, 4.5, and 2.5 inches of liquid hydrogen, at angles of 0°, 15°, 37°, 53°, and 78°; water measurements were made for 1.5 and 6.4 inches at the same angles. A description of the liquid hydrogen experimental facility is given, including design considerations. Also included is a discussion of the development of the isotropic fast neutron source and differential neutron spectra taken with this source. Author

N65-19752*# Case Inst. of Tech., Cleveland, Ohio.
SURVEY OF KNOWN LASER TRANSITIONS
H. J. Cook, W. B. Johnson, and Marcia L. Parsons Sep. 1964 95 p refs
(Grant NsG-198)
(NASA-CR-57334; A-32) CFSTI: HC $3.00/MF $0.75

A list is presented of approximately 700 spectral lines of observed laser transitions, of which the vast majority were observed in gas lasers. Elements and molecules used to produce laser action in the gas phase include argon, bromine, carbon, chlorine, cesium, CN, CO, CO_2, helium, mercury, HCN, iodine, krypton, nitrogen, neon, oxygen, OD, OH, sulfur, and xenon. Elements whose ions have been used to produce laser action in a host material include chromium, dysprosium, europium, gadolinium, holmium, neodymium, nickel, praseodymium, samarium, thulium, uranium, and ytterbium. Wavelengths produced by gas lasers range from 0.2678μ to 337μ, and those produced by solid lasers range from 0.3125μ to 2.7μ. D.E.W.

N65-19766*# Southern Methodist Univ., Dallas, Tex.
BASIC RESEARCH IN SEMICONDUCTOR DETECTOR-DOSIMETER CHARACTERISTICS, AS APPLIED TO THE PROBLEMS OF WHOLE BODY DOSIMETRY Informal Progress Report
George W. Crawford Feb. 1965 3 p
(Grant NsG-708)
(NASA-CR-57300) CFSTI: HC $1.00/MF $0.50

A family of lithium-drifted silicon semiconductor detectors for measuring the stopping power of protons and proton absorption is reported. Stopping power measurements have been

made for protons of 5 to 187 MeV in metals, plastics, and tissue. Depletion depth, volume, noise level, charge pulse per MeV, dark current, and capacitance are being measured for each detector. A program for calculation of the linear stopping power has been completed, tested, and incorporated into a Monte Carlo transport program which permits Coulomb interaction with both orbital electrons and the nuclei. Also, the Monte Carlo program has been written to permit calculation of the depth dose distribution in skin, muscle, and fat. E.E.B.

N65-19796# Midwestern Universities Research Association, Madison, Wis.
ALGORITHMS FOR RELAXATION CALCULATION OF FFAG MAGNETOSTATIC FIELDS
S. C. Snowdon 10 Feb. 1965 27 p refs Prepared for ANL (MURA-706) CFSTI: $2.00

A method of developing algorithms for a general second-order differential equation of the elliptic type is given. Application is made to the development of algorithms for an FFAG magnetostatic guide field. Algorithm modifications are found for points near a two-dimensional edge of ideal iron that removes the analytical difficulty occasioned by the presence of infinite fields on the edge. Author

N65-19803# National Lead Co. of Ohio, Cincinnati.
EXPERIENCES IN BLENDING FOR ISOTOPIC ADJUSTMENT
W. E. Shaw AEC, Washington, 12 Oct. 1964 16 p refs
(TID-21330) CFSTI: $1.00

Successful isotopic adjustments were accomplished in blending solids when a large enough portion of the resultant blend was homogenized prior to analysis. Liquid-liquid blending either by solution, molten salt, molten metal or reduction-to-metal techniques resulted in blends homogeneous within the limits of analysis. The techniques involving liquid–liquid blending are preferred to obtain an isotopically uniform product. Author

N65-19817# Atomic Energy Commission, New York. Health and Safety Lab.
THE BOUNDARY EFFECT ON GAMMA-RAY TRANSPORT FROM A POINT SOURCE
Keran O'Brien and James E. Mc Laughlin Oak Ridge, Tenn., AEC, Jan. 1965 26 p refs
(HASL-157) CFSTI: $2.00

The density interface effect on γ-ray intensities resulting from a point source was measured at 0.66 and 1.25 MeV. Source-detector separations from about 10 to 900 meters were employed. A phenomenological representation is suggested of this effect, based on a two-dimensional diffusion equation. Author

N65-19870*# Space Technology Labs., Inc., Redondo Beach, Calif.
CHARGED PARTICLE RADIATION DAMAGE IN SEMICONDUCTORS, X: THE ENERGY DEPENDENCE OF ELECTRON DAMAGE IN SILICON
3 Sep. 1964 43 p refs
(Contract NAS5-3805)
(NASA-CR-57478; STL-4161-6004-KU-000) CFSTI: HC $2.00/MF $0.50

Test specimens of both p on n, and n on p silicon solar cells, and bulk n-type and p-type silicon materials were investigated for their use in satellite solar cell power supply systems. Experiments were performed to (1) obtain statistically significant and accurate data on the energy dependence of electron radiation damage, (2) determine the effect of resistivity on the damage rate and energy dependence, and (3) to obtain added specimens and information for further analysis of the energy levels and defect mechanisms responsible for electron damage in silicon. An accurate energy dependence function over the range from 0.4 to 40.0 MeV was established. Extrapolation of the damage rate versus energy characteristics indicates the superior radiation resistance of the n on p cell to the p on n cell to electron energies beyond 1 BeV. Theoretical analysis of the electron degraded n on p solar cells indicate that an energy level 0.17 eV below the conduction band controls the recombination. The Hall coefficient data for the energy dependence of the defect introduction rate were found roughly similar to the energy dependence of solar cell degradation. G.G.

N65-19886*# Radio Corp. of America, Princeton, N. J. RCA Labs.
RADIATION DAMAGE IN SILICON First Semiannual Report, Oct. 15, 1963–Apr. 15, 1964
N. Almeleh, B. Goldstein, Y. Shaham, and J. J. Wysocki Greenbelt, Md. NASA. Goddard Space Flight Center, May 1964 34 p refs
(Contract NAS5-3788)
(NASA-CR-57505) CFSTI: HC $2.00/MF $0.50

Electron paramagnetic resonance studies at 27° K of a newly observed center in electron-irradiated p-type silicon yielded the following information. The principal axes are $<221>$, $<1\bar{1}0>$, and $<11\bar{4}>$ with respective g-values of 2.0000, 2.0066, and 2.0056. Preliminary measurements of introduction rates at various bombardment energies are 0.25 cm^{-1} at 6.6 MeV, 0.22 cm^{-1} at 5.5 MeV, and 0.15 cm^{-1} at 3.0 MeV. Studies of the effects of impurities on radiation characteristics in silicon include diffusion length measurements using surface-barrier diodes and EPR measurements of lithium-doped silicon. Techniques were successfully applied to the fabrication of the diodes and to lithium doping of the silicon. The paramagnetic resonance due to lithium was observed at 27° K. It consists of one narrow line with a g-value of 1.9997. Bombardment-induced changes in the photovoltaic parameters of Si p/n, Si n/p, and GaAs p/n solar cells were measured for protons with energies in the range 185 to 545 keV. In the GaAs cell, the short-circuit current changed most during irradiation, while in both types of Si cells the shape of the I-V characteristic and the open-circuit voltage were more sensitive to radiation than the short-circuit current. The rate of change of these parameters per incident particle increases with proton energy. Author

N65-19914*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
DAMAGE TO GERMANIUM DUE TO 22 AND 40 MeV PROTON BOMBARDMENTS
Roger A. Breckenridge and Chris Gross Washington, NASA, Mar. 1965 20 p refs
(NASA-TN-D-2727) CFSTI: HC $1.00/MF $0.50

The effects of 22 and 40 MeV proton bombardments on n- and p-type single-crystal germanium were investigated. Electrical conductivity and the Hall coefficient were measured as a function of proton flux to provide removal rates for majority carriers. A defect energy level was located in n-type germanium 0.20 ±0.01 eV below the bottom of the conduction band from a study of the Hall coefficient as a function of temperature and, also, from a study of the removal rate of electrons as a function of the Fermi level. The rate of introduction of acceptor levels in n-type germanium was found to be 73.5 per

cm-proton for irradiation with 22 MeV protons and 41.4 per cm-proton for irradiation with 40 MeV protons. The measured removal rates of holes in p-type germanium were much lower than the removal rates of electrons in n-type germanium at a similar resistivity and for the same bombarding particles. A limiting value of the Fermi level was located between 0.20 and 0.25 eV above the top of the valence band. Author

N65-19933# Nuklearni Institut Josef Stefan, Ljubljana (Yugoslavia).

Na^{23} MAGNETIC RESONANCE STUDY OF THE FERROELECTRIC TRANSITION IN ROCHELLE SALT

R. Blinc, J. Petkovsek, and J. Zupancic Sep. 1964 17 p refs Submitted for Publication

(NIJS-R-436)

The angular dependence of the second-order quadrupole shifts of the Na^{23} magnetic resonance was measured in the two paraelectric phases of both deuterated and normal Rochelle salt, as well as in the intermediate ferroelectric phase, where an additional splitting of the Na^{23} lines was found. The electric field gradient (EFG) tensors at the sodium sites were determined. The results of a point charge model calculation show that the changes in the EFG tensors on going from the low temperature paraelectric to the ferroelectric phase can be explained by a displacement of two out of the four O(5)–H hydrogens and O(8) water molecules in the unit cell, the principal component of the displacement vector pointing in the direction of the ferroelectric axis. Author

N65-19934# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

EXPERIMENTAL VERIFICATION OF A REMOVAL AGE—DIFFUSION MULTIGROUP PROGRAM IN A THERMAL COLUMN

F. Zerdin and V. Dimic Sep. 1964 8 p refs Presented at the IAEA Meeting, Study Group on Res. Reactor Exptl. Tech.

(NIJS-R-437)

A removal age—diffusion multigroup program, with only four energy intervals in the removal group for a bulk shield was experimentally verified in the thermal column of the heavy water experimental 6.5-MW reactor. Thermal and epithermal neutron fluxes were measured in a usual manner by using bare and cadmium covered Au and In foils. The measured cadmium ratio is accurate in the high flux region close to the reactor core. In the low flux region the experimental accuracy was not sufficient to get reliable results. The measured and calculated values of R_{Cd} are not in quite good agreement. The relative values of the calculated and measured thermal fluxes agree satisfactorily all the way through the thermal column, except at the outer face. The absolute values disagree due to normalization uncertainties. Author

N65-19936# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

THE ASYMPTOTIC ANGULAR DEPENDENT LEAKAGE SPECTRUM OF THERMAL NEUTRONS

R. Kladnik Aug. 1964 20 p refs Submitted for Publication

(NIJS-R-435)

The application of the variational method in velocity-dependent transport theory is described for the case of a pulsed infinite slab. The extrapolated end point and the buckling as functions of the slab thickness are calculated from a given transcendental equation. The expression for the angular and energy distribution of leaking neutrons was improved by one iteration of the integral transport equation. The results are discussed for three different scattering models; monatomic gas, Nelkin water, and the Egelstaff model. It is found that Nelkin's model gives a better estimate for the integral constants, whereas the Egelstaff's law is more suitable for the differential spectrum calculations. Author

N65-19937# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

ELECTRON SPIN RESONANCE OF IRRADIATED $NaH_3(SeO_3)_2$ AND $NaD_3(SeO_3)_2$

R. Blinc, S. Poberaj, M. Schara, and J. Stepisnik Oct. 1964 11 p refs Submitted for Publication

(NIJS-R-439)

The electron spin resonance spectra of γ-irradiated $NaH_3(SeO_3)_2$ $NaD_3(SeO_3)_2$ single crystals were investigated, and the principal stable damage centers could be identified as SeO_2^-. The spectra consist of a central part, due to those SeO_2^- groups which are composed of spinless isotopes of Se, and of a number of satellites due to hyperfine interaction with Se^{77}. At room temperature four physically nonequivalent free radicals were found in the unit cell of nonpolar NaHSe and NaDSe, two of them being also chemically nonequivalent, and the complete g and hyperfine coupling tensors were determined. Significant changes occur in the spectra on cooling the samples below the corresponding ferroelectric (NaHSe) respectively antiferroelectric (NaDSe) transition points, demonstrating a doubling of nonequivalent defect sites. Author

N65-19938# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).

EFFECT OF IONIZING RADIATION ON THE FERROELECTRIC CURIE TEMPERATURE OF $NaH_3(SeO_3)_2$

R. Blinc, P. Cevc, and D. Vovk Nov. 1964 4 p refs

(NIJS-R-442)

In order to determine the influence of gamma-ray damage on the ferroelectric crystal, $NaH_3(SeO_3)_2$ transition temperature, the temperature dependence of the dielectric losses was measured by the cavity perturbation method on samples subjected to various stages of gamma-ray damage. Also, the ferroelectric hysteresis loops were measured by the Sawyer-Tower circuit. The dose rate was 0.26 Mrep/hour. The temperature dependence of the dielectric losses showed two distinct maxima of different intensity. One of these two maxima occurred at a temperature where a lowering of crystal symmetry was detected in the electron spin resonance spectra and where spontaneous polarization appeared. The second maximum has nothing to do with the ferroelectric transition. No changes in the ferroelectric hysteresis loops were found after a 68 $\times 10^3$ rep irradiation. After 408 $\times 10^3$ rep dose the original hysteresis loop started to split into two separate loops. E.E.B.

N65-19950# Battelle Memorial Inst., Columbus, Ohio.

THE MIGRATION OF GASEOUS AND SOLID FISSION PRODUCTS IN IRON-20 w/o CHROMIUM AND IRON-29 w/o NICKEL-13 w/o CHROMIUM

Arthur A. Bauer, ed. 20 Oct. 1964 43 p refs

(Contract W-7405-ENG-92)

(BMI-1696; EURAEC-1267)

The behavior of fission gases in iron-20 w/o chromium alloy was studied by measuring release of Xe^{133} from recoil-impregnated surfaces, by concentration-gradient measurements, through inpile release measurements, and by electron microscopic techniques. The mechanism suggested to explain all of the results requires the clustering or trapping of the fission gases within the alloy. Solid-fission-product diffusion measurements were performed from 600° to 1200° C on iron-20 w/o chromium and iron-29 w/o nickel-13 w/o chromium alloys.

Two types of diffusion processes were observed. In the body-centered-cubic iron-20 w/o chromium alloy, tellurium, ruthenium, and molybdenum diffused with frequency factors (D_o) and activation energies (Q) which fell in the range predicted for a normal vacancy process, being similar to those for self-diffusion. Cerium, barium, iodine, and zirconium–niobium gave considerably lower values of D_o and Q in the iron-20 w/o chromium alloy, while in the face-centered-cubic iron-29 w/o nickel-13 w/o chromium alloy all elements exhibited the second type of behavior with low values for D_o and Q. Author

N65-20034# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
SECONDARY NUCLEONS PRODUCED IN HIGH ENERGY NUCLEAR REACTIONS
W. R. Yucker Dec. 1964 120 p refs
(SM-46334; AD-611855)

Results of a study to provide basic nuclear data necessary for space radiation shielding calculations are reported. Presented are empirical relations for nonelastic cross sections, cascade yields, residual nuclear excitation, evaporation yields and secondary energy and angular distributions. These results provide a model for the calculation of differential cross sections for secondary nucleon production by nucleons incident on a wide range of target nuclei. S.C.W.

N65-20055# General Dynamics, Fort Worth, Tex. Nuclear Aerospace Research Facility
EXCITATION OF ETHYLENE, ACETYLENE, PROPYNE, AND 1-BUTYNE BY LOW-ENERGY ELECTRON IMPACT Technical Report, 1 Oct. 1963–30 Sep. 1964
C. R. Bowman and W. D. Miller Kirtland AFB, N. Mex., AF Weapons Lab., Jan. 1965 33 p refs
(Contract AF 29(601)-6213)
(FZK-213; WL-TR-64-148; AD-612070)

The excitation spectra of ethylene, acetylene, propyne, 1-butyne, 2-butyne, and 3-hexyne have been measured by means of a trapped-electron technique which permits the detection of approximately 93% of inelastically scattered electrons independent of scattering angle. Excitation potentials and relative intensities are tabulated for both optically allowed and optically forbidden transitions. Correlation with available ultraviolet absorption data and molecular-orbital theory is used to establish transition assignment. A 1.7-eV excitation in ethylene is attributed to temporary negative-ion formation. In acetylene at 2.0 eV, excitation is postulated as resulting from excitation of the triplet $^3\Sigma_u^+$ state. Low-energy maxima occur in propyne, 1-butyne, and 2-butyne; however, the complexity of these molecules precludes a meaningful assignment of transitions at this time. Author

N65-20083# California Univ., Los Angeles.
NUCLEAR OPTICAL MODEL CALCULATIONS
Michel A. Melkanoff, Tatsuro Sawada, and Jacques Raynal Jan. 1965 128 p refs Submitted for Publication Sponsored by NSF, ONR and AEC

This article reviews the methods used in optical model calculations and indicates how to speed up the computations while retaining desired accuracy in the results. All the formulas required to compute the final quantities of interest are presented. The numerical solutions of the radial Schroedinger differential equations are discussed in some detail as these calculations represent an important part of the total computation. The equations are usually solved by the Runge-Kutta, Cowell or Noumerov methods which are compared. The final errors in the coefficients of the scattering matrix are discussed and illustrated for a typical test case. Several methods for automatically searching over the parameter space for the best fit to the experimental data are discussed and compared. Author

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N65-18663# RAND Corp., Santa Monica, Calif.
MAGNETOHYDRODYNAMIC-HYPERSONIC VISCOUS AND INVISCID FLOW NEAR THE STAGNATION POINT OF A BLUNT BODY
M. C. Smith, C. S. Wu (JPL), and H. S. Schwimmer Jan. 1965 19 p refs
(Contracts NAS7-100; AF 49(638)-700)
(RM-4376-PR; AD-610623)

This report numerically investigates the hypersonic viscous and inviscid flow past a spherical body which contains a magnetic dipole field alined with the flow. Local-similarity solutions of the flow field are assumed near the stagnation point. The solution found differs from previous solutions in that the magnetic field is defined on the body rather than at the shock. The numerical results indicate that the critical values of the magnetic interaction parameter no longer appear as in previous works and that the shock displacement is much larger than formerly found for magnetic interaction parameters less than one. The latter result suggests that a magnetic field is a more useful device for controlling the hypersonic flow about a body than previously thought. Author

N65-18664# Electro-Optical Systems, Inc., Pasadena, Calif.
BASIC RESEARCH ON GAS FLOWS THROUGH ELECTRIC ARCS–THE RADIATING ARC COLUMN Interim Technical Report
G. L. Marlotte, R. L. Harder, and R. W. Prichard Wright-Patterson AFB, Ohio, ARL, Dec. 1964 69 p refs
(Contract AF 33(657)-7940)
(ARL-64-49, Pt. II; AD-610545)

Simple analytic expressions are derived for describing the radiation from an arc confined in a cylindrical constrictor and operating in the general gas-heating or inlet regime. These expressions were obtained by postulating linear relationships among the plasma properties, σ, u, and ϕ,—the electrical conductivity, the power radiated per unit volume, and the thermal conductivity integral $\int_0^T K dt$, respectively. For initial comparisons, radiation from fully developed arcs in argon and nitrogen has been measured as a function of the arc current and the gas pressure in the confining cylinder. These measurements are compared to the appropriate limit in the analytical predictions and the correlation is found to be good, except for the electric field dependence upon current. It has been found possible to improve the correlation by modifying the results of the analysis to include, in an approximate manner, the nonlinear relationships that actually exist among the properties of the plasma. Author

N65-18666# Yale Univ. Observatory, New Haven, Conn.
INTERACTION OF RADIATION AND MATTER IN A PLASMA
Final Technical Report
Ludwig Oster Wright-Patterson AFB, Ohio, ARL, Nov. 1964 48 p refs
(Contract AF 33(657)-7271)
(ARL-64-202; AD-610946)

The following areas are treated: (1) the radiation spectrum emitted under the simultaneous action of Coulomb forces and an external magnetic field; (2) the radiation emitted by free particles in the neighborhood of the plasma frequency where the collective behavior of the plasma electrons becomes the dominant factor; (3) the radiative transfer problem in dispersive media which relates the observable spectrum of a plasma source to the internal parameters, such as temperature and density; (4) departures from thermodynamic equilibrium in continuous energy states, when the radiative interactions can be separated from collisional transitions; and (5) relativistic corrections that turned out to be negligible under the conditions envisaged in the preceding paragraphs. Author

N65-18669# Air Force Systems Command, Wright-Patterson AFB, Ohio. AF Materials Lab.
PRELIMINARY STUDY OF A RADIO FREQUENCY PLASMA
Technical Documentary Report, Dec. 1963–Aug. 1964
Paul J. Huffman and Edmund J. Rolinski Dec. 1964 22 p refs
(ML-TDR-64-317; AD-458426)

A radiofrequency discharge of an argon plasma operating at one atmosphere was studied. The operating parameters of the plasma such as oscillator frequency, arc configuration, and argon flow rate were determined. The properties of the radiofrequency discharge such as degree of ionization, temperature, shape of discharge, intensity, acoustical fluctuations, and penetration of discharge (skin depth) were determined. Author

N65-18863# General Motors Corp., Santa Barbara, Calif. GM Defense Research Labs.
THE PLASMA-SHEATH-INDUCED RADAR ABSORPTION EFFECT IN HYPERSONIC BALLISTIC RANGES
William E. Blore and Henry M. Musal, Jr. Jan. 1965 10 p refs
(Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj. Defender)
(CTN65-03; AD-457524)

A theoretical explanation was found for the large decrease in the radar cross section of a blunt metal body that occurs when the body is covered by a very thin plasma sheath. The decrease depends on partial coverage of the body by the overdense plasma layer. The angular gradients of the plasma properties around the body were found to be the cause of severe diffraction of the radar wave. The details of the effect depend so critically upon the distribution of ionization in the plasma sheath that the effect may be useful as a flow field diagnostic. D.E.W.

N65-18864# University of Southern Calif., Los Angeles. Electrical Engineering Dept.
WIND TUNNEL INVESTIGATION OF THE INTERACTION OF RADIO WAVES WITH SHOCK-IONIZED FLOW FIELDS
Final Report, Jan. 1960–Dec. 1964
Z. A. Kaprielian Dec. 1964 200 p refs
(Contract AF 19(604)-6195)
(USCEC-82-219; AFCRL-65-7; AD-457512)

Wind tunnel investigations and work in steady-state hot plasma facilities on wave propagation experiments are summarized. Theoretical studies discussed include interaction of electromagnetic waves with plasma and its possible applications in reentry communication and detection, ionospheric propagation, plasma diagnostics, and related areas. Classical electromagnetic wave problems are also discussed, emphasizing solutions to problems of diffraction and radiation associated with dielectric materials. E.P.V.

N65-18953# California Univ., Livermore. Lawrence Radiation Lab.
ADVANCED RESEARCH IN CONTROLLED FUSION
Harold P. Furth and Richard F. Post 10 Dec. 1964 18 p
(Contract W-7405-ENG-48)
(UCRL-12234) CFSTI: $1.00

The plasma stability problem is universally recognized as the central problem in controlled-fusion research. An analysis is presented to show that the most direct road to practical fusion power is to be found in the type of directed basic research activity that also has first-rate status as science. Basic theory technology, experimental physical methods, and the experience to tackle the fusion problem are available. The immediate concern is with physics, not engineering. The past decade's efforts have already solved some of the most difficult practical problems. Already, hot plasmas of substantial density have been produced and confined for significant lengths of time. Experiments illuminating critical aspects of plasma stability have been performed. E.E.B.

N65-18983# American Science and Engineering, Inc., Cambridge, Mass.
PERFORMANCE OF LANGMUIR PROBES IN MEASUREMENTS ABOARD A REENTRY VEHICLE Final Report
Shimshon Frankenthal 31 Jan. 1964 54 p refs
(Contract AF 19(628)-2367; ARPA Order 363-62)
(ASE-510; AFCRL-64-975; AD-610257)

The theory of Langmuir probes is reviewed. Particular attention is accorded to the interpretation of data obtained when the probe is in saturation, and to plasmas in which the characteristic ion and electron energies are comparable. Various methods for interpreting the probe measurements are enumerated. This information is employed in the subsequent discussion, which concerns the performance of Langmuir probes flown aboard a reentry vehicle, and the interpretation of data telemetered from these probes. Author

N65-18985# California Inst. of Tech., Pasadena. Div. of Engineering and Applied Science
STABILITY OF A CONDUCTING FLUID FLOWING DOWN AN INCLINED PLANE IN A MAGNETIC FIELD
Din-yu Hsieh Dec. 1964 24 p refs
(Contract Nonr-220(28))
(Rept.-85-29; AD-610013)

A stability analysis is made for the laminar flow of a layer of a viscous and electrically conducting fluid down an inclined plane in a transverse magnetic field. It is found that the effect of the magnetic field, revealed through the Hartmann number, is to stabilize the flow. A simpler and physically clearer approximate treatment of the same problem based on the principle of local balance is also given. The results agree quite satisfactorily with the exact analysis. Author

N65-18991# MHD Research, Inc., Newport Beach, Calif.
EXPLOSIVE MAGNETOHYDRODYNAMICS Third Quarterly Technical Progress Report, 1 Oct.–31 Dec. 1964

Malcolm S. Jones, Jr., Francis H. Webb, Jr., Paul Webster, Sydney Handlin, Richard Harrison et al 15 Jan. 1965 38 p refs
(Contract AF 33(615)-1594)
(MHD-666; AD-610639)

Experimental studies on the production of short-duration pulses of electrical power by MHD principles in a radial flow channel are presented. Plasma currents in excess of 10^4 amperes were measured in a radially expanding explosive-driven plasma. The plasma conductivity was less than had been expected on the basis of experiments conducted in linear channels. Designs for generators capable of producing electrical power outputs up to 4×10^{12} watts for 10 microseconds are discussed. Author

N65-19001# Sylvania Electric Products, Inc., Waltham, Mass. Applied Research Lab.
SELF AND MUTUAL ADMITTANCES OF WAVEGUIDES RADIATING INTO PLASMA LAYERS Scientific Report No. 5
J. Galejs 1 Sep. 1964 38 p refs
(Contract AF 19(628)-2410)
(AFCRL-64-1000; AD-611202)

The self and mutual admittance of waveguide backed slots radiating into a plasma (or dielectric) layer was formulated in a laterally unbounded geometry. The admittance expression involves integrals that may be approximated by summations for numerical calculations. For a constant mesh size approximation to the integrals the summations are the same as obtained in earlier work, where the plasma layers are considered to be within a wide waveguide. The accuracy of the solution is improved by decreasing the mesh size used for the numerical integration, which is equivalent to increasing the size of the large guide in the waveguide model. Mutual admittance calculations between two-parallel slots show that the presence of a plasma layer decreases the mutual admittance relative to its free space value. Author

N65-19012# AeroChem Research Labs., Inc., Princeton, N. J.
AN ANOMALOUS EFFECT OF MAGNETIC FIELD ON STAGNATION-POINT HEAT-TRANSFER IN A SUPERSONIC PLASMA Final Technical Report, 1 Dec. 1962–30 Nov. 1963
S. A. Gordon Wright-Patterson AFB, Ohio, ARL, Nov. 1964 60 p refs
(Contract AF 33(657)-10341)
(ARL-64-209; AD-609214)

Investigation of the effect of a dipole-like magnetic field on heat transfer to a forward stagnation point in a Mach 3 argon plasma led to a surprising result. Rather than indicating a change in heat transfer coefficient, the measurements point to a change in the flow field of such a nature that the effective recovery temperature of the gas at the stagnation point is reduced. This effect is much larger than that which present continuum theory predicts, is dependent on conditions upstream of the test section and is also a function of magnetic field direction. Author

N65-19032# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IONIZATION OF SUPERSONIC STREAM OF MERCURY VAPOR BY A BEAM OF HYDROGEN IONS
A. D. Abramenkov, V. F. Rybalko, and Ya. M. Fogel' 4 Dec. 1964 16 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii Fiz. (Tomsk), no. 5, 1963 p 75–81
(FTD-TT-64-626/1+2+4; AD-609923)

The possibility of obtaining multicharged ion beams from a plasma formed by the ionization of a supersonic stream of mercury vapor by a beam of hydrogen ions is investigated. It is shown that a beam current is limited by the space charge in the region between the ionization zone and the suction probe. Author

N65-19070# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
PLASMA OSCILLATIONS AND WAVES, PART I Scientific Report No. 231
O. E. H. Rydbeck 10 Jan. 1965 133 p refs
(Contract AF 19(628)-4014; Grant NSF GP-2914)
(AFCRL-64-976; AD-610804)

This report deals with the wave propagation and oscillation properties of a one or two component plasma in the absence of a static magnetic field. It is assumed that the electrons behave as a continuous fluid and the total wave field is split up into electromagnetic and plasma modes. It is shown that the total field can be described by three potentials, viz, one vector, one scalar electromagnetic, and one scalar plasma potential. The gradient coupling between the electromagnetic and plasma modes is discussed and exemplified. The plasma wave radiation from transient or moving point sources is discussed. The electron and ion velocity distribution is taken into account. The complex ω-values are analyzed and discussed as functions of the plasma wave number k. The limited validity range of the Landau damping formula is demonstrated graphically. A discussion of higher order plasma modes is also included. The possibilities of obtaining growing waves in two stream media are analyzed in some detail, for electron–electron as well as for ion–electron streams. Author

N65-19102# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
SHOCK STRUCTURE IN A PARTIALLY IONIZED GAS
Michel Y. Jaffrin Oct. 1964 81 p refs
(Contract Nonr-1841(93))
(Publ.-64-9)

The one-dimensional, steady-state structure of a shock wave in a partially ionized gas is investigated using the Navier–Stokes equations for the atom, electron, and ion fluids. The plasma is assumed quasi-neutral without a change in ionization across the shock. The effects of the ion–atom diffusion or ion slip, which is measured by the velocity and temperature differences between ions and atoms, were studied. It was found that an experimental measurement in partially ionized hydrogen of the variation of potential in a strong shock gives a shock thickness and a potential rise across the imbedded shock in good agreement with the calculated values. D.E.W.

N65-19107# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
EXCITATION OF ION OSCILLATIONS IN BEAM-PLASMA SYSTEMS
M. T. Vlaardingerbroek 18 Sep. 1964 35 p refs
(Contract DA-36-039-AMC-03200(E); Grants DA-SIG-36-039-61-G14; NSF G-24073)
(RLE-TR-426; AD-607269)

This report suggests possible ways for further theoretical study of the interaction of an electron beam and the ions in a hot-electron plasma. We obtain the equations for beam–plasma interaction in a filled cylindrical waveguide in which the thermal velocity distribution is longitudinal but otherwise

arbitrary. We describe an approximation based on these equations by using only one transverse wave number. A close resemblance is found between the approximate solutions and the theory of plane waves in an infinite beam–plasma system, traveling at an angle with the direction of the beam and the magnetic field and having a certain fixed real transverse wave number. We take advantage of this resemblance and calculate beam–(hot-electron) plasma interaction including a transverse random velocity distribution. We combine the theory of a filamentary beam and a plasma-filled waveguide, using the coupling-of-modes theory, for the description of some of the weak interactions between a thin beam and a finite plasma. Author

N65-19117# Arkansas Univ., Fayetteville. Plasma Lab.
RESEARCH ON THE INTERACTIONS OF PLASMA FLOW AND MAGNETIC FIELDS Quarterly Progress Report No. 3, May 15–Aug. 15, 1964
Denys O. Akhurst et al [1964] 16 p refs
(Contract DA-23-072-AMC-168(Z))
(UAPL-19; AD-612124)

Theoretical and experimental work was performed on the magnetohydrodynamics and superconductivity of plasma flows and magnetic fields. An expression for the voltage generated by moving plasma interactions with the magnetic field of a solenoid was formed. Tabulated values and graphs, which show the relationship between the various theories applicable to certain ranges of gas ionization for a temperature range of 3000° to 30 000° K, were gained by computation. A conductivity curve for a plasma jet at low input power as a function of the discharge current in a jet nozzle was found by radiofrequency oscillator observations. Steady-state measurements of the jet velocity by a three-gap triggering mechanism were made at various flow levels and the values are presented in a table. Several tests at low input power obtained data for the amount of heat exchange at the electrodes, and it was found that at higher than 10-kW input power different kinds of electrodes must be used. The feasibility of adapting the theory of ac induction generators to magnetohydrodynamic power generation was investigated successfully for a channel with a rectangular cross section. G.G.

N65-19128# AVCO-Everett Research Lab., Everett, Mass.
RADIATION FROM A GAS CONTAINING ALKALI METAL VAPORS
Robert H. Thomas Jan. 1965 23 p refs
(Contract AF 04(694)-414)
(AMP-152; BSD-TDR-64-164; AD-611127)

This report derives an approximate analytic expression for the radiant energy flux from a plasma contained in an infinite plane parallel enclosure. Author

N65-19131# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASMA DIAGNOSTICS
S. Lukianov 25 Nov. 1964 12 p Transl. into ENGLISH from Metanviereba da Tekhnk (USSR), no. 10, 1959 p 4–7
(FTD-TT-64-100/1+2+3+4; AD-609143)

The practical methods used in plasma research are discussed, with emphasis on homogeneity and pressure measurements under standard conditions to realize a controlled thermonuclear reaction. Optical devices based on the Doppler effect seem to be most suitable to transmit quickly and correctly the changing characteristics of a hot plasma by observation of the light frequency in relation to the observer. Frequency shifts up to the violet spectrum indicate approaching rays, and shifts toward the red spectrum indicate recession of the light rays. At high temperature, ionized hydrogen atoms can be traced by mixing hydrogen with helium, nitrogen, or neon, and by observation of the spectral line broadening due to impurity atoms. It is concluded that it is impossible to demonstrate experimentally the existence of a plasma heated to a temperature higher than a few million degrees. G.G.

N65-19132# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PLASMA DIAGNOSTICS
S. Lukianov 25 Nov. 1964 13 p Transl. into ENGLISH from Metaniereba da Tekhn. (USSR), no. 11, 1959 p 14–17
(FTD-TT-64-101/1+2+3+4; AD-609147)

The fast time scan of a plasma life by the use of a rotating mirror and instantaneous film exposure is described, and the graphic recording of the short-lived development of an electronic light flash passing through a small tube filled with hydrogen during a low-pressure cycle is presented. Photographs of the electronic impulse expansion through the hydrogen filled tube in the region of the spectrum, where ordinary nonionized hydrogen produces no lines at all, showed the plasma formation at maximum ionization at one and a half million degrees. Several techniques to measure the pressure and density of a plasma are discussed, and a probing of the plasma with microwaves is favored. G.G.

N65-19223# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
A SURVEY OF CESIUM PLASMA RESEARCH
John A. Decker, Jr. Dec. 1964 44 p refs
(ARL-64-220; AD-611833)

A critical survey of past and present research on the plasma physics of cesium is presented. Primary emphasis is on the utilization of the unique characteristics of cesium in plasma generation and measurement. In addition, reference is made to work of historical interest and to several current applications of cesium plasma technology. Author

N65-19224# Northeastern Univ., Boston, Mass.
MICROWAVE AND OPTICAL PLASMA DIAGNOSTICS Final Report, 1 May 1961–30 Nov. 1964
Theodore J. Morin, Jr. and George R. Peacock 30 Nov. 1964 39 p refs
(Contract AF 19(604)-8462)
(AFCRL-64-903; AD-610846)

The theory used and some experiments involved in making electron density measurements are described. Microwave and optical interferometric techniques are presented in detail. Electrostatic probe theory is summarized, and the apparatus which was constructed to perform these measurements is also described in detail. Techniques are reported for performing several electron density measurements simultaneously. The emphasis has been on microwave and optical methods, with single and double probes included only for substantiation. It is concluded that extremely passive-type measurements, such as optical interferometric methods, in particular with the use of a laser as a light source, will be among the most important plasma diagnostic techniques. Author

N65-19338# Argonne National Lab., Ill. Reactor Engineering Div.
A STUDY OF UNSTEADY MAGNETOHYDRODYNAMIC FLOW AND HEAT TRANSFER

Ralph M. Singer Nov. 1964 39 p refs
(Contract W-31-109-ENG-38)
(ANL-6937) CFSTI: $2.00

The unsteady, combined free and forced convective flow of an electrically conducting fluid through a transverse magnetic field is analyzed. Allowing the channel wall temperature to vary linearly with the axial coordinate of the duct allows a fully developed flow situation that linearizes the governing equations and permits on analytical solution. The unsteadiness may occur because of variations in the axial pressure gradient, wall temperature, or internal energy generation rate. The effects of the thermal and magnetic Prandtl numbers (Pr and Pr_m), the Hartmann number (M), the Rayleigh number (Ra), and internal energy generation upon the flow and heat transfer are studied. Oscillatory behavior is observed for large values of Ra and M and for Pr near unity, and the length of the transient period is found to depend strongly upon these parameters. Author

N65-19402*# California Univ., Livermore. Lawrence Radiation Lab.
MICROWAVE EXCITATION OF A LIVERMORE PUFFATRON PLASMA AT THE ELECTRON CYCLOTRON FREQUENCY
J. L. Shohet (Johns Hopkins Univ.) and J. F. Steinhaus 13 Jan 1965 17 p refs
(Contract W-7405-ENG-48)
(UCRL-12057, Rev. I) CFSTI: $1.00

A Puffatron device was operated in conjunction with a microwave signal at the electron cyclotron frequency. Two wavelengths were used: 8 mm and 3 cm (X-band). The 3-cm radiation was pulsed at 40 kW for 2 μsec, while the 8-mm radiation was operated continuously at 15 W. The most informative results were obtained with the 3-cm radiation. When the radiation was applied during the afterglow of the Puffatron discharge, a burst of light and a signal on Langmuir loop and capacitance probes were observed. Author

N65-19413# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
RESEARCH ON HYPERSONIC RAREFIED PLASMA FLOWS Final Report, 15 Oct. 1963–14 Oct. 1964
Sinclaire M. Scala 13 Nov. 1964 35 p refs
(Contract AF 49(638)-1283)
(AFOSR-64-2471; AD-609496)

A descrete ordinate technique for the linearized Boltzmann equation with application to Couette flow is presented. Also, a modified form of the Chapman and Enskog transport theory for gas mixtures, developed for a neutral, binary mixture with disparate molecular weights, is reported. E.E.B.

N65-19439# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
DIAGNOSTIC EXPERIMENTS IN A MAGNETICALLY DRIVEN SHOCK TUBE
John B. Heywood (Ph.D. Thesis) 31 Dec. 1964 61 p refs
(Contracts DA-36-039-AMC-03200(E); Nonr-1841(93); (TR-428; AD-610583)

During a series of experiments in hydrogen in a magnetic annular shock tube with an applied axial magnetic field, measurements of the front speed were made over as wide a range of initial gas pressure, initial drive bank voltage, and axial magnetic field as possible. These results were compared with the predicted speeds obtained from the Kemp and Petschek solutions and the snowplow model, and reasonable agreement was obtained. Measurements were also made on the front properties with magnetic and electric field probes inside the annulus, and with phototubes. It was found that a substantial fraction of the drive current always flows in the front, and no shock wave preceding the current sheet was observed. A detailed picture of the current distribution inside the annulus was obtained, and a current loop was found to flow behind the front. Electric field measurements substantiated this picture. It was also shown that when the Alfvén speed ahead of the front was comparable with the front speed, the flow pattern changed significantly. Author

N65-19456# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
TRANSMISSION AND REFLECTION OF ELECTROMAGNETIC WAVES BY A HOT PLASMA
E. C. Taylor 30 Nov. 1964 26 p refs
(Contract AF 04(695)-469)
(TDR-469 (5220-10)-3; SSD-TDR-64-267; AD-456354)

The relativistic form of the Vlasov equation is used to solve the problem of transmission and reflection of normally incident electromagnetic waves. Transmission and reflection coefficients are derived for a plasma half-space and for a plasma slab, using the assumption that electrons are specularly reflected at the boundaries. These coefficients are functions of the ratio of the electron thermal speed to the vacuum speed of light, indicating that temperature dependence in these cases is a relativistic effect. Nevertheless, it is seen that the nonrelativistic limits of these coefficients differ from those obtained by using the cold-plasma equations, since the transition to the zero-temperature limit has a nonuniform character. Author

N65-19468# Case Inst. of Tech., Cleveland, Ohio.
RAYLEIGH'S PROBLEM IN MAGNETOGASDYNAMICS WITH HALL EFFECT
Pau-Chang Lu 1965 37 p refs
(Grant NSF G-19000)

The boundary layer solutions for large times of the velocity and temperature distributions in a gas, induced by the impulsive motion of an infinite flat plate in its own plane, are obtained by using the Karman–Pohlhausen technique. The gas is assumed to be thermally ionized through a combination of dissipative effects and heat supplied at the plate. Two examples are given for seeded argon at about 2500° K: one with Hall effect (strong magnetic field), and one without. An example of the corresponding incompressible problem is solved both approximately and exactly, to throw some light on the possible error involved in applying the Karman–Pohlhausen technique to the present problem. Author

N65-19475# Max-Planck Institut für Physic und Astrophysik, Munich (West Germany).
DETERMINATION OF THE M+S-COIL-CONFIGURATION BY MEANS OF AN ANALOGOUS EXPERIMENT [BESTIMMUNG DER M+S-SPULENFORM DURCH EIN ANALOGEXPERIMENT]
H. Bialas Jan. 1965 27 p refs in GERMAN; ENGLISH summary
(MPI-PAE/PI-1/65)

In a high frequency analogous model in which the plasma is simulated by a copper form representing a M+S-surface that coil shape was found which produces a constant magnetic field on the M+S-surface. In the elaborated optimal configuration the field on the M+S-surface is constant within ±(1.4±0.3)%. For a plasma with equal volume but constant

cross section in a normal torus the field decay is ± 4.2%. The drift time of a plasma in the elaborated configuration is accordingly prolonged by a factor

$$\sqrt{\frac{4.2}{1.4\pm0.3}} = 1.8\pm0.2$$

It seems possible to reduce the field deviation to ±0.25% by improving the technique of measuring. The drift time is then prolonged by a factor

$$\sqrt{\frac{4.2}{0.25}} \approx 4.$$

Author

N65-19506*# National Aeronautics and Space Administration, Washington, D. C.

INVESTIGATION OF THE INTERACTION OF PLASMA FLOWS IN A TRANSVERSE MAGNETIC FIELD [ISSLEDOVANIYE VZAIMODEYSTVIYA PLAZMENNYKH POTOKOV V POPERECHNOM MAGNITNOM POLE]

V. G. Zykov, N. G. Sinitsa, I. A. Stepanenko, V. T. Tolok, and K. D. Sinel'nikov Mar. 1965 17 p refs Transl. into ENGLISH from Zh. Tekh. Fiz. (Leningrad), v. 34, no. 8, 1964 p 1417–1423

(NASA-TT-F-9282) CFSTI: HC $1.00/MF $0.50

Plasma guns and special targets were used to study the polarization interaction of plasma flows in a transverse magnetic field. A polarized plasma stream, moving in a transverse field, decreases in density at increase in field strength. On frontal collision of oppositely directed plasma flows, strong deceleration and even complete arrest takes place. In contrast to Coulomb interaction, plasma interaction does not take place in the depth of the plasma jets but in their frontal region, leading to turbulence and vortex formation. Presumably, this interaction takes place also in the absence of Coulomb interaction. Photographs of plasma glow and oscillograms for both types of interaction are given. Author

N65-19554# Plasmadyne Corp., Santa Ana, Calif.

A FUNDAMENTAL THEORETICAL AND EXPERIMENTAL STUDY OF ROTARY MAGNETOHYDRODYNAMICS Final Report

Victor A. Erma and Boris Podolsky 21 Jan. 1964 94 p refs

(Contract AF 49(638)-1149)

(FR113-1149; AFOSR-64-2475; AD-609812)

A combined theoretical and experimental investigation of the magnetohydrodynamics of a magnetically driven vortex, including both a closed cycle (homopolar) and open cycle (helical) configuration was made. Most of the theoretical analysis was concerned with the case of an incompressible fluid, although a preliminary analysis of a compressible fluid was also made, while all of the experimental work was carried out with mercury as a conducting fluid. The theory of the magnetohydrodynamics of the homopolar device for the general case of an incompressible conducting fluid is presented, and the resulting system of equations simplified appreciably. Detailed discussions of the two special cases of very high and very low conductivity are given. The cases of a homopolar device with a compressible fluid, and a helical device with an incompressible fluid are likewise discussed in a preliminary manner. A detailed experimental study of the homopolar device, including exhaustive measurements of the static pressure, azimuthal and radial velocities, boundary layer behavior, and the effect of a changing electrode radius was made. Author

N65-19595# Atomic Energy Commission, Oak Ridge, Tenn. Div. of Technical Information

CONTROLLED FUSION AND PLASMA RESEARCH—A LITERATURE SEARCH

Sidney F. Lanier, comp. Jan. 1965 573 p refs

(TID-3557, Suppl. 2) CFSTI: $6.00

A total of 3657 annotated references to research reports and journal articles are cited, covering work on fusion reactions, plasma physics, magnetohydrodynamics, magnetic fields, and other topics related to research in controlled fusion. Report number, availability, and author indexes are provided. Author

N65-19652# New York Univ., N. Y. Magneto-Fluid Dynamics Div.

COLLISIONLESS SHOCKS AND SOLITARY WAVES

Cathleen S. Morawetz 30 Nov. 1964 12 p refs Presented at 11th Intern. Congr. of Appl. Mech., Munich, 1964

(Contract AT(30-1)-1480)

(NYO-1480-12; MF-44)

Interest in collision-free magnetohydrodynamic shock centers around the apparent detached shock which buffers the earth and its magnetic field from the solar wind. Around the earth there is a large vacuum field. A stream of plasma, the solar wind, has to pass around this vacuum field which acts roughly like a body in a supersonic stream. The solar wind is slowed down by crossing a shock and then slips around the vacuum field. An idealized mathematical model is presented to examine this problem theoretically. It was found that the detached shock data computed by Spreiter and Jones fit quite well. Even for a turbulent flow the standard shock and contact discontinuity relations hold if the fine structure is small. E.E.B.

N65-19672# American Meteorological Society, Boston, Mass.

HYDROMAGNETIC WAVES IN PLASMA [UBER HYDROMAGNETISCHE WELLEN IN PLASMEN]

Winfried Otto Schumann Bedford, Mass., AFCRL, Aug. 1964 17 p refs Transl. into ENGLISH from Z. Angew. Phys. (West Berlin), v. 11, no. 7, 1959 p 259–264

(Contract AF 19(628)-3880)

(T-G-228+; AD-453052)

The propagation of electric waves for a magnetized plasma with a strong, constant, impressed magnetic field B for the case $\Omega_E \gg \nu_e$ and $\Omega_J \gg \nu_J$, with allowance for electron diffusion is discussed. If $\omega \ll \nu$, electron diffusion is negligible and the wave is propagated along and across the magnetic field in exactly the same manner with a phase velocity $v_p = v_{A_J}\sqrt{2\omega/\nu_J}$, where the wave is damped to $e^{-2\pi}$ after one wavelength. The Alfven velocity is $v_{A_J} = B/\sqrt{\mu N m_J}$ for positive ions and ν_J is the number of collisions of the ions per second. The wavelength is

$$\lambda = 2\pi v_{A_J}\frac{\sqrt{2}}{\omega\nu_J}.$$

Further, the undamped case with $\nu \to 0$ is discussed, and it was found that in strongly magnetized plasmas with $B^2/\mu \gg NkT_E$ the phase velocity of the waves along and across the magnetic field is $v_p = v_{A_J}$. The velocity of sound has no effect in this case. In conclusion, the importance of the eigenmotion of the electron block in the discussion of the waves is noted. Author

N65-19708*# Consultants and Designers, Inc., Arlington, Va.

INTERPRETATION OF CERTAIN PHENOMENA OF THE MAGNETOSPHERE BY PLASMA INSTABILITIES [INTERPRETATION DE CERTAINS PHENOMENES DE LA MAGNETOSPHERE PAR DES INSTABILITES DE PLASMA]

Robert Stefant and Guy Vasseur 29 Mar. 1965 5 p refs Transl. into ENGLISH from Compt. Rend. Acad. Sci. (Paris), v. 260, no. 10, 1 Feb. 1965 p 1465–1467
(Contract NAS5-3760)
(NASA-TT-F-9660; ST-PF-10312) CFSTI: HC $1.00/MF $0.50

The interaction of a beam of particles with a cold plasma, composed of electrons and only one kind of ion, and placed in the earth's magnetic field is considered. A homogenous, indefinite, homokinetic beam of electrons and protons is assumed of a lower density than the plasma it crosses, and the interaction of the beam with the plasma is expressed in the dispersion equation:

$$F(w,k) = w^2 - k^2 c^2 - \frac{\Omega_1^2 w^2}{(w - \Omega_{11})(w + \Omega_1)}.$$

It was found that this plasma-beam system gives way to an emission of low frequency, and another, of three frequencies, two of which can be very close, depending upon the value of the parameters. G.G.

N65-19717*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
KELVIN-HELMHOLTZ INSTABILITY IN AN ANISOTROPIC PLASMA
S. P. Talwar Oct. 1964 14 p refs
(NASA-TM-X-55143; X-641-64-305) CFSTI: HC $1.00/MF $0.50

The Kelvin–Helmholtz instability, due to a tangential discontinuity of velocities between two streams of a homogeneous, nondissipative, anisotropic plasma, is investigated. Use is made of the modified single fluid hydromagnetic equations where heat flow is neglected, and the independent components of anisotropic pressure are determined by the two adiabatic equations of state instead of the single equation of state of the ideal fluid theory. Results obtained should apply to situations intermediate between those of weak collisions and strong collisions, i.e., the situations in which collisions are not sufficiently strong to keep the pressure a scalar but sufficiently strong to prevent the heat flow and other transport processes. E.E.B.

N65-19782* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion
INVESTIGATION OF Na-K SEEDED ARGON PLASMA
Hsuan Yeh, Chad F. Gottschlich, and T. K. Chu *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965 7 p (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The measurement of nonequilibrium ionization and its effects in an alkali metal (Na–K) seeded argon plasma, where the nonequilibrium ionization is produced by an externally applied electric field, is discussed. Improvement of the Na–K alloy injection system eliminated the leakage of alloy between the cyclinder and piston that occurred in earlier designs. A new alloy boiler to vaporize the alloy to be mixed with the argon was constructed and tested. Recent tests showed that the quartz test section rapidly devitrifies during operation. This appears to be due to traces of oxygen and water vapor present in the argon. It is known that oxygen and water vapor can react with Na–K alloy to form oxides that, in turn, react with the quartz. E.E.B.

N65-19804# RCA Victor Co., Ltd., Montreal (Canada). Research Labs
FOCUSSED MICROWAVE SYSTEMS FOR PLASMA DIAGNOSTICS
A. I. Carswell and C. Richard Dec. 1964 184 p refs
(Contract DRB PD-69-400007)
(RCA Res. Rept.-7-801-32)

The usefulness of focused microwave beams for plasma diagnostics is investigated both theoretically and experimentally. Scalar diffraction theory is used to describe the amplitude and phase behavior of a microwave beam in the focal region of a lens system, and simplified expressions for the beam properties are presented in terms of an effective beam width, W, and depth of field, D. Dielectric lenses are used to produce focused microwave beams at 10 and 35 Gc/sec. and the properties of the laboratory systems are compared with the theoretical predictions. The dependence of the focal properties on such parameters as lens illumination, microwave frequency, lens F-number and image position are studied in some detail. The properties of a double lens system for multiple focused beam plasma diagnostics are also described. The limitations of focused beams for quantitative measurements of plasma properties are discussed. Author

N65-19818# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
ELECTRON-STREAM INTERACTION WITH PLASMAS Special Technical Report No. 10
Richard J. Briggs 1964 197 p refs Book *Its* Res. Monograph No. 29
(Contract DA-36-039-AMC-03200(E); Grants DA-SIG-36-039-61-G14; NSF G-24073)
(AD-454587)

The adopted model plasma is a fully ionized gas composed of particles which interact only through the large-scale macroscopic electromagnetic fields. These particles can then be described within the framework of the collisionless Boltzmann–Vlasov equation. This analysis deals with the full distribution of velocities and includes the effects of the Landau and cylcotron damping. The criteria for distinguishing between amplifying and evanescent waves and for determining absolute instabilities are presented. Waves propagating along the steady magnetic field in an unbounded beam-plasma system are considered. These waves consist of the electrostatic longitudinal wave independent of the steady magnetic field, and the transverse circularly polarized waves in which the electromagnetic fields are perpendicular to the steady magnetic field. The interaction in a cold plasma of finite extent in the plane transverse to the steady magnetic field is analyzed. Various limiting cases are studied in order to obtain analytical results. The low frequency interaction with ions in a hot-electron plasma of finite transverse dimensions is considered. E.P.V.

N65-19862*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
EXPERIMENTAL INVESTIGATION OF THE FUNDAMENTAL MODES OF A COLLISIONLESS PLASMA Quarterly Report No. 1, Mar. 10–Jun. 10, 1964
J. H. Malmberg 22 Jun. 1964 6 p
(Contract NAS7-275)
(NASA-CR-57469; GACD-5403) CFSTI: HC $1.00/MF $0.50

Modifications of the experimental machine and the development of instruments necessary for the experiment are reported. Measurements on the plasma properties are also discussed. The new probe manipulators necessary for the experiment were built, and electromagnetic coupling between the probes was greatly reduced by using a shielding technique. The signal-to-noise ratio of the receiver was also materially improved. A number of measurements on the geometry of the plasma and on the noise in the plasma were made. D.E.W.

N65-19888*# Case Inst. of Tech., Cleveland, Ohio. Physics Dept.
TRANSPORT PROPERTIES OF A TURBULENT LORENTZ GAS Technical Report No. A-33
Eugene N. Frank (Ph.D. Thesis) Jan. 1965 171 p refs
(Grant NsG-198)
(NASA-CR-57433) CFSTI: HC $5.00/MF $1.00

The fields of a turbulent Lorentz gas with average magnetic field are expressed in terms of fluctuating quantities. The equations of conservation of momentum and matter are used along with Maxwell's equations to obtain a Fourier-analyzed momentum equation in terms of the fluctuating velocities alone. Nonlinear terms are linearized through the use of a dynamic viscosity-like term after Heisenberg. The study is then restricted to a semicompressible plasma. It is found that in general six modes of wave motion are possible; three are modified classical modes and the others are mixed or turbulent modes which express the cross correlation between the classical modes present in the turbulence. Numerical results are obtained for the indices of refraction and the mobilities for the various modes. One of the most important results of the analysis is the appearance of an enhanced diffusion above a certain critical value of the magnetic field. Author

N65-19889*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
EXPERIMENTAL INVESTIGATION OF THE FUNDAMENTAL MODES OF A COLLISIONLESS PLASMA Quarterly Report No. 3, Sep. 11–Dec. 10, 1964
J. H. Malmberg and C. B. Wharton 22 Dec. 1964 7 p refs
(Contract NAS7-275)
(NASA-CR-57434; GACD-6009) CFSTI: HC $1.00/MF $0.50

Elimination of the helix and the use of probes to launch cyclotron waves in a collisionless H_2 plasma resulted in the cataloging of three distinct plasma waves between the electron cyclotron frequency and the upper hybrid frequency. The two waves above the cyclotron frequency constituted a fast forward wave of $v_\phi > c$, and a slow wave with phase-retarding frequency. The fastest wave below the cyclotron frequency seemed to be a plasma perturbed TE_{mn} waveguide whose cross section is 1/10 filled with plasma. Other observed cyclotron waves may be higher modes having circumferential field variations. The effects of various plasma densities and cyclotron frequencies on the cyclotron family of waves are represented on graphs. G.G.

N65-19896*# General Dynamics Corp., San Diego, Calif. John Jay Hopkins Lab. for Pure and Applied Science
EXPERIMENTAL INVESTIGATION OF THE FUNDAMENTAL MODES OF A COLLISIONLESS PLASMA Quarterly Report No. 2, Jun. 11–Sep. 10, 1964
J. H. Malmberg 22 Sep. 1964 5 p refs
(Contract NAS7-275)
(NASA-CR-57437; GACD-5716) CFSTI: HC $1.00/MF $0.50

The design of an antenna in the shape of a helix surrounding the plasma column is reported. The antenna acts as a slow wave structure for the transmitter signal. Also the dispersion relation observed for waves near electron cyclotron frequency is given. The plasma frequency in this case is less than the electron cyclotron frequency. E.E.B.

N65-19952# General Telephone and Electronics Labs., Inc., Bayside, N. Y.
OPTICAL PROPERTIES OF BINARY GAS PLASMAS Technical Report, 15 Nov. 1963–14 Sep. 1964
W. R. Watson and V. J. Fowler Wright-Patterson AFB, Ohio. AFSC, 30 Nov. 1964 26 p
(Contract AF 33(615)-1050)
(TR-64-257.10; AFAL-TR-64-289; AD-609125)

This report describes a project (1) to determine changes that occur in the composition of the gas during operation of a discharge tube such as is used in helium–neon lasers, and (2) to develop suitable instrumentation for such investigations. The omegatron mass spectrometer system developed is described, and data obtained with it on a helium–neon laser are reported. The laser output power and intensities of some lines of the emission spectrum of the discharge are also reported as functions of time of continuous operation of the laser. Author

N65-19965# Sperry Rand Research Center, Sudbury, Mass.
PULSE DISPERSION IN A GYROTROPIC PLASMA Scientific Report No. 2, May–Dec. 1964
H. J. Schmitt Jan. 1965 45 p refs
(Contract AF 19(628)-4183)
(SRRC-RR-65-16; AFCRL-65-91; AD-458638)

The dispersion of nanosecond electromagnetic pulses in a longitudinally magnetized plasma confined in a coaxial transmission line is observed experimentally. The transient response exhibits weakly damped oscillations characteristic of the natural frequencies of a bounded gyrotropic plasma. Measurements of the pulse dispersion caused by reflection from the plasma interface and transmission through the plasma are compared with theoretical results obtained on the basis of a dielectric model of the plasma, in which ion motion and random motions of electrons are neglected. The dispersion of pulsed electromagnetic waves in isotropic plasmas is observed for different ratios between the carrier frequency and the plasma frequency. Measurements of signal distortion are compared with theoretical results obtained by a convolution of the impulse response. The effect of superimposed magnetic fields on the dispersion of rf pulses in a plasma is discussed. Author

N65-20110*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
VALID CONDITIONS FOR THE KRAMERS-UNSOLD CONTINUUM THEORY IN A NON-EQUILIBRIUM PLASMA
Che Jen Chen 30 Dec. 1964 7 p refs
(Contract NAS7-100)
(NASA-CR-57527; JPL-TR-32-707) CFSTI: HC $1.00/MC $0.50

The Kramers–Unsöld theory of continuum intensity for electron-ion recombination is formulated quantum mechanically. The valid conditions for the theory in a nonequilibrium plasma are deduced by using Griem's criterion for partial local thermodynamic equilibrium. The results indicate that the conditions are much less restricted than those required for the Saha equation to be valid. Author

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N65-18665# General Electric Co., Schenectady, N. Y. Research Lab.
RESEARCH ON CdTe Interim Report

R. E. Halsted, D. T. F. Marple, and B. Segall Wright-Patterson AFB, Ohio, ARL, Sep. 1964 54 p refs
(Contract AF 33(616)-8264)
(ARL-64-145; AD-610801)

The results are summarized of a 3-year program of basic research on CdTe, a semiconducting compound of interest for solar battery and injection luminescence applications. These studies were concerned with the physical chemistry of the system Cd-Te and with investigations of intrinsic properties and properties of native defects of high-purity CdTe single crystals. Both optical and electrical techniques were employed. Fourteen publications resulting from this work are cited by abstract. Preliminary manuscripts of two additional unpublished studies are included in their entirety. Author

N65-18695# Phillips Labs., Inc., Irvington-on-Hudson, N. Y. Research Lab.
STUDY AND MATERIAL DEVELOPMENT OF MAGNETOSTRICTIVE FERRITE ELEMENT Final Report
F. G. Brockman, P. W. Beck, and W. G. Steneck 12 Jul. 1963 92 p refs
(Contract NOw-63-0223-c)
(TR-163; AD-413050)

A study was made of the ferrite system $Mn_xFe_{(1-x)}Fe_2O_4$ as materials for magnetostrictive transducer applications. A region of compositions in this system exhibits coupling coefficients in excess of 30% with a maximum value exceeding 50%. A beginning was made in the reduction of the electrical conductivity of the composition possessing this maximum in the coupling coefficient. A detailed electromechanical analysis of this latter material is reported. Similar detailed studies are given for $Co_{0.01}Fe_{0.99}Fe_2O_4$ and for $FeFe_2O_4$. In certain of the more (electrical) conducting materials eddy current effects are observed. Performance tests were made on transducer elements and these elements were fabricated from two varieties of ferrite transducer materials. Ten bar-type samples of magnetostrictive ferrite elements were fabricated and tested (without external loading). Author

N65-18707 Joint Publications Research Service, Washington, D.C.
RARE EARTH ELEMENTS AS ACTIVATORS OF LUMINOPHORES
V. L. Levshin *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 71–80 refs (See N65-18701 09-17) CFSTI: $7.00

Energy curves in the emission spectra of ZnS and ZnS · Ag self-activated phosphors are compared with the curve for AnS · Sm activated by rare earth metals (REM). Other data on REM as activators include optical characteristics of phosphors, temperature variation in development of luminescene of silver and samarium ions in ZnS · Ag · Sm phosphors, and quantum light generation by REM-activated luminophores. J.M.D.

N65-18712 Joint Publications Research Service, Washington, D.C.
THERMOELECTRONIC EMISSION OF OXIDES OF THE RARE EARTH METALS
B. V. Bondarenko, S. V. Yermakov, and B. M. Tsarev *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 117–129 refs (See N65-18701 09-17) CFSTI: $7.00

In a study of rare earth metals (REM) for use in cathodes, thermoelectric emission of all oxides of all the REM except promethium are cited. At temperatures around 1700°, the effective work function of oxides of all REM lies within the range 3.3 ± 0.1 eV. The minimum value of the work function in the state of stable activity is within 2.9 ± 0.15 eV, while for maximum activity it is within 2.75 ± 0.2 eV. Analysis of data in the literature suggests that oxides of lanthanum, samarium, and dysprosium may be appropriate materials for cathodes, although final recommendation awaits study of vapor pressure of the REM oxides. J.M.D.

N65-18890 Library of Congress, Washington, D.C. Aerospace Technology Div.
GAS-PHASE RADIATION-INDUCED GRAFT POLYMERIZATION: A PREPARATIVE METHOD FOR COHERENT SEMICONDUCTING POLYMERBASED MATERIALS
Serge Markov *In its* Foreign Sci. Bull. Feb. 1965 p 39–43 refs (See N65-18884 09-34)

Coherent organic semiconductor materials were prepared by gas-phase ionizing-radiation-induced graft polymerization. The development of this technique is reviewed, and its advantages and potential value are discussed. Author

N65-18933*# IIT Research Inst., Chicago, Ill. Technology Center
HIGH-TEMPERATURE ELECTRICAL PROPERTIES OF INSULATORS AND THEIR COMPATIBILITY WITH REFRACTORY METALS Summary Report
Richard F. Havell and Frederick C. Holtz 3 Mar. 1965 169 p refs
(Contract NAS3-4104)
(NASA-CR-54125; IITRI-B6016-17) CFSTI: HC $5.00/MF $1.00

The dc resistances of alumina, magnesia, beryllia, and boron nitride were determined in tests between 1100° and 1600° C in nitrogen, hydrogen, and vapors of mercury and cesium. Using the two-probe technique, current measurements were made with tungsten electrodes at voltages between 0 and 180 dcV over periods of a few hours to 100 hours. The mechanical properties and electrical resistance of tungsten, tantalum, molybdenum, TZM, and 90Ta-10W were measured after the metals were heated in contact with the above insulator materials in various atmospheres and vacuum, both with and without an applied dc voltage. These tests were run at elevated temperatures for periods of a few hours to 98 hours. Author

N65-18981# Philco Corp., Blue Bell, Pa. Philco Scientific Lab.
A FUNDAMENTAL STUDY OF EPITAXY BY FLASH EVAPORATION Third Semiannual Scientific Report
John L. Richards 30 Sep. 1964 38 p refs
(Contract AF 19(628)-2937)
(AFCRL-64-918; AD-610133)

Electrical measurements were made on InSb films deposited on mica substrates. The perfection of isoepitaxially deposited InSb films was studied using X-ray double diffractometer methods. Films of high crystalline quality were deposited. Author

N65-18986# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Metallurgy and Ceramics Research Lab.
AN ANNOTATED BIBLIOGRAPHY OF RESEARCH ON THE STRUCTRUAL AND PHYSICAL PROPERTIES OF ZIRCONIA
Berthold C. Weber Nov. 1964 94 p refs
(ARL-64-205; AD-610758)

This bibliography covers the literature of the past 35 years although some older references are included because they are often quoted. Three hundred and seven references have been individually evaluated. The discussion of the subject is arranged in 12 sections dealing with topics of particular interest to the researcher. It is emphasized that inadequately defined test materials and insufficient control of experimental conditions are the main reasons for conflicting literature data concerning the structural and physical properties of zirconia. Author

N65-18990# Midwest Research Inst., Kansas City, Mo.
THE STRUCTURE AND STRENGTH OF EPITAXIAL FILMS Final Report, 17 Oct. 1963–17 Nov. 1964
Melvin Lavik, Paul Stablein, and Paul J. Bryant 5 Jan. 1965 47 p refs
(Contract NOw-64-0061-d)
(AD-609730)

An ultrahigh-vacuum (UHV) evaporator system was developed for depositing pure, epitaxial films. Pressures of 10^{-10} torr were obtained. A tensile test device was incorporated to permit straining the film–substrate composites while still in the clean UHV environment. Preliminary load displacement curves were obtained for polycrystalline silver substrates with and without gold films. Techniques were investigated for separating gold films from mica and sodium chloride substrates. An apparent grown-in compressive strain was observed as the film was relieved during separation from a sodium chloride substrate. Preliminary tensile tests of these free films were conducted. Recommended future experiments as well as recommended modifications of equipment and techniques are given. Appended is a bibliography of pertinent literature references. Author

N65-18994# Dartmouth Coll., Hanover, N. H. Dept. of Physics and Astronomy
ELECTRICAL BEHAVIOR OF IONIC CRYSTALS Final Summary Report
Robert W. Christy Dec. 1964 5 p refs
(Contract Nonr-3897(04))
(AD-610042)

The thermoelectric power in a number of halide systems was studied with emphasis on defect concentration and mobility of ionic crystals through doping effects, and material variations of the metallic electrodes. Silver chloride and silver bromide yielded thermoelectric values for the heats of defect formation and migration in agreement with those derived from conductivity measurements, and gave values for the heats of transport that were large and temperature dependent. Sodium chloride with foreign metal electrodes yielded comparable values for the heats of transport but of a low accuracy. Cuprous chloride with Cu- and $CdCl_2$-doped electrodes yielded similar values to those of silver halides, except for some low temperature effects due to the limited solubility of the $CdCl_2$ impurity. A preliminary thermoelectric experiment on the TlCl system with Tl metal electrodes was abandoned after a discoloration of the salt was observed. It is believed that this impurity is caused by the formation of Tl_2O. G.G.

N65-19003# Massachusetts Inst. of Tech., Cambridge. Crystal Physics Lab.
INVESTIGATION OF THE PHYSICAL NATURE OF PHOTOELECTRIC TRAPPING AND RECOMBINATION CENTERS IN SINGLE CRYSTAL MATERIALS Final Report
A. Smakula 22 Dec. 1964 89 p refs *Its* Tech Rept.-5
(Contract AF 19(604)-8483)
(AFCRL-64-1024; AD-611181)

In continuation of our study of trapped charge-carrier centers in KCl, RbCl, KBr, RbBr and in their solid solutions, the systems RbCl-RbBr and KBr-RbBr were investigated. Crystals of various compositions were irradiated with electrons, 3 MeV, 10^4 to 10^8 rads at temperatures 20°, −80° and −190° C. The influence of radiation dose, irradiation temperature and crystal composition on spectral position, half width, and intensity of the electron and hole trapped centers was studied. A variety of bands (M, F, K, V_k, V_1 and V_2 and some others) were observed. In no case is the Mollwo relation valid. In solid solutions the shift of most bands does not go linearly with the composition but deviates toward lower energy. The half width of bands in solid solutions is always greater than in pure components. The concentration of trapped centers increases with irradiation, but at a decreasing rate. Most of the observed bands have been correlated to already known models, but the correlation of some new ones (L_x, V_x) is still uncertain. Author

N65-19021# Martin Co. Baltimore, Md. RIAS Div.
AN INVESTIGATION OF THE DEFECT SOLID STATE Final Report, 1 Jan. 1962–31 Dec. 1964
H. Peiffer and J. N. Maycock [1964] 48 p refs
(Contract Nonr-3707(00))
(AD-610364)

The effect of prior deformation and recovery on the defect concentration during plastic deformation for copper, and the recovery of defects from 78° to 300° K for cadmium are reported. It was found: (1) Room temperature recovery of copper appeared to enhance defect production and thereby the work-hardening rate, at least at the beginning of a new deformation. (2) From 98° to 118° K, recovery in cadmium was not too similar to the recovery in cold-worked copper. (3) Defects introduced into cadmium lightly worked at liquid nitrogen temperatures showed similarity to those of other metals of different crystal structure. E.E.B.

N65-19025# Ion Physics Corp., Burlington, Mass.
PN JUNCTION FORMATION TECHNIQUES Final Report, Oct. 1963–Aug. 1964
W. J. King et al 15 Nov. 1964 195 p refs
(Contract AF 33(615)-1097)
(APL-TDR-64-113; AD-608636)

This report describes investigations performed over 1 year on fabrication of silicon single-crystal cells by ion implantation techniques and thin-film cells by plasma deposition techniques. The n on p cell efficiencies have been raised to the 13% level (tungsten −2800° K −140 mw/cm^2) through improvements in the implantation process, subsequent heat treatment, and contacting. Control of the junction characteristics and therefore cell spectral response through the inherent control of the implantation technique was conclusively demonstrated. All factors directly involved in making these cells were investigated in detail. Plasma deposition as a process was studied in detail. Much of the program involved investigations with source feed gases (silicon halides) which were incompatible with formation of semiconductor grade films by this process. Experiments with silicon hydride resulted in functional (low resistivity, doped, highly crystalline, low impurity level) films on foreign substrates (molybdenum and quartz), thereby demonstrating the basic tenets of the plasma deposition process. The excellent characteristics of the film formed indicate that cell formation is basically achievable with further development of doping techniques. Author

N65-19045# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
SPUTTERING YIELDS OF ALKALI HALIDE SINGLE CRYSTALS BOMBARDED BY 2- TO 10-keV IONS
B. Navinsek Aug. 1964 6 p refs Submitted for Publication
(NIJS-R-434)

Fresh (100) cleavage faces of sodium chloride, potassium chloride, potassium bromide, and lithium fluoride single crystals were bombarded by Ar^+ ions under normal incidence. Sputtering yields for these crystals in the energy range from 2- to 10-keV are between 0.30 and 2.15 atoms/ion. The ion bombardment apparatus and experimental conditions are briefly described. Author

N65-19097# Utah Univ., Salt Lake City. Dept. of Ceramic Engineering
DIELECTRIC LOSS IN MgO AND SAPPHIRE
Gary Spencer Snow and Ivan B. Cutler Nov. 1964 123 p refs
(Contract Nonr-1288(06))
(TR-1; AD-609617)

Dielectric loss measurements were made on single crystal MgO and sapphire and on pure and doped polycrystalline MgO. The measurements were made in air and in dry argon gas at audiofrequencies from room temperature to approximately 800° C. Both two- and three-terminal measuring apparatus were used in the investigation. The loss was atmospheric dependent in both single crystal MgO and sapphire. The peaks were attributed to chemisorbed water on the sample. The relaxation time obeyed the equation $\tau = \tau_0 e^{\Delta H^+/kT}$ where ΔH^+ was 1.4 eV in both cases and τ_0 was 1.6×10^{-14} sec for the MgO peaks and 0.53×10^{-14} sec for the Al_2O_3 peaks. In the case of the polycrystalline MgO samples doped with more than 0.1% cation iron, large conductivities in conjunction with a high resistance between platinum foil electrodes and sample gave rise to interfacial polarization loss peaks. The relaxation time obtained from these peaks was used as a measure of the ac conductivity as a function of iron concentration and sample treatment. Author

N65-19104# General Electric Co. Syracuse, N. Y. Semiconductor Products Dept.
RESEARCH ON MICROWAVE INTERACTIONS IN SEMICONDUCTORS Technical Documentary Report, Dec. 1962–May 1964
R. W. Aldrich, J. P. Dietz, and S. Wanuga Wright-Patterson AFB, Ohio, AF Avionics Lab., Sep. 1964 144 p refs
(Contract AF 33(657)-10088)
(AL-TDR-64-179; AD-610604)

This study has two tasks—to produce and evaluate distributed semiconductor structures, and to study design methods and principles for solid-state ultrasonic amplifiers. The first task included the fabrication and evaluation of a long, narrow silicon p-n junction diode and the analysis of a microwave device using such a diode as the active element. The devices were fabricated in a novel manner by oxide masking and diffusion techniques which are described. The achieved device parameters were 60 pfd/linear inch capacitance and a cutoff frequency of about 2 Gc/s. A 20-mil wide segment of one of the long diodes was packaged in a microwave cartridge. The capacitance was about 5 pf at 1 Mc/s. The initial objective of the work on the acoustic amplifier was to obtain net gain from the device. Theoretical calculations of operating characteristics of the acoustic amplifier were performed. Experimental amplifiers operating in the 30 to 90 Mc range were built, and several amplifiers exhibited net gains of approximately 23 dB. Author

N65-19112# Sperry Rand Research Center, Sudbury, Mass.
INVESTIGATION OF THE ELECTRICAL AND OPTICAL PROPERTIES OF JUNCTIONS IN VAPOR-DEPOSITED COMPOUND SEMICONDUCTORS Semiannual Scientific Report
Henry T. Minden Dec. 1964 20 p refs
(Contract AF 19(628)-4189)
(SRRC-RR-64-105; AFCRL-65-30; AD-611431)

Germanium was epitaxially deposited on gallium arsenide by means of the hydrogen reduction of $GeCl_4$. Above 800°, germanium reacted with the GaAs seed to form a black powder. Proper deposition was observed below about 750°. Nonetheless, cross doping of the Ge layer by gallium was observed even at deposition temperatures as low as 670° ; the heterojunctions showed tunnel diode characteristics. Deliberately doped junctions of p-Ge on n-GaAs showed the I–V characteristics of Ge junctions, while the photovoltaic response was that of a GaAs junction. Epitaxial lasers were made by the deposition of zinc-doped epitaxial layers on n-type GaAs substrates. It was necessary to codeposit tin along with the zinc. The threshold current density was about 1.3×10^4 A/cm^2. Author

N65-19317# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE RESEARCH, 1 JULY 1964–30 SEPTEMBER 1964
A. L. Mc Whorter et al 17 Dec. 1964 74 p refs
(Contract AF 19(628)-500)
(ESD-TDR-64-561; AD-609828)

The topics covered are *Solid State Device Research, Laser Research, Materials Research, Band Structure and Spectroscopy of Solids,* and *Magnetism and Resonance.* Author

N65-19354# Perkin-Elmer Corp., Norwalk, Conn. Electro-Optical Div.
RESEARCH AND DEVELOPMENT OF NEW LASER MATERIALS Final Report, 1 May–30 Sep. 1964
Robert C. Linares 30 Oct. 1964 54 p refs
(Contracts AF 19(628)-4057; AF 19(628)-2965)
(M7881; AFCRL-64-971; AD-611177)

Crystals of $Al_2O_3:Mn^{4+}$, $Al_2O_3:Cr^{3+}$, $Al_2O_3:V^{2+}$, MgO: Cr^{3+}, $Ga_2O_3:Cr^{3+}$, $Al_4SiO_8:Cr^{3+}$, $MgAl_2O_4:Cr^{3+}$ $MgAl_2O_4$: V^{2+}, $BeAl_2O_4:Cr^{3+}$ and $Gd_3Ga_5O_{12}:Cr^{3+}$ were grown for laser and spectral evaluation. The physical and optical measurements were made on the crystals, which were grown utilizing the flame fusion, Czochralski, flux, and vapor techniques. Recommendations are made regarding the potential for future study of each material. Author

N65-19403# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
MAGNETIC SHIELDING TRANSITION IN SOLID CeF_4
M. Pintar Jun. 1964 5 p refs Submitted for Publication
(NIJS-R-428)

Since cerium tetrafluoride is diamagnetic, a symmetric F^{19} nuclear magnetic resonance absorption line is expected for a polycrystalline sample, if there is no chemical shift anisotropy. Such a symmetric line, independent of both temperature and magnetic field has previously been observed at temperatures from 125° to 287° K. At 287° K the absorption line becomes asymmetric. At 297° K there is considerable broadening of the absorption pattern, and the line width increases linearly with increasing temperature. The absorption pattern was graphically disentangled at 358° K into two symmetrical components. At this temperature, the mean chemical shifts of both components differ for 510 ppm. The splitting of the

F^{19} absorption line is very likely the result of a structural transformation generating two magnetic unequivalent F sites in CeF_4 lattice. E.E.B.

N65-19442# Illinois Univ., Urbana. Dept. of Ceramic Engineering
DEFECT STRUCTURE FERROELECTRICS Technical Report, Sep. 1961–May 1964
V. J. Tennery 20 Jun. 1964 72 p refs
(Contract Nonr-1834(38))
(TR-1; AD-601675)

The dielectric and X-ray structural properties of the system $NaNbO_3$–$Sr_{0.5}NbO_3$ were determined from the end number $NaNbO_3$ to the limit of the solid solution at $Na_{0.50}Sr_{0.25}NbO_3$. A ferroelectric phase was found to exist in this system beyond a concentration of 10 mole% of $SrNb_2O_6$. No distinct morphotropic phase boundary between this ferroelectric phase and the antiferroelectric phase of $NaNbO_3$ was observed. The subcell symmetries of the compositions studied in the system were determined as functions of temperature. It was determined that the ferroelectric phase in this system possesses a multiple cell perovskite structure related to the antiferroelectric structure of pure $NaNbO_3$. The weak superstructure lines exhibited in the X-ray patterns of $NaNbO_3$ and these solid solutions vanished when the perovskite subcell edge attained a value of 3.941Å. Author

N65-19480# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
LARGE AREA SEMICONDUCTOR SURFACE PASSIVATION PRODUCTION REFINEMENT PROGRAM Interim Technical Progress Report, 1 Apr.–30 Jun. 1964
H. C. Evitts, D. Peterson, D. Tolliver, and A. Epstein Jul. 1964 73 p
(Contract AF 33(657)-11268)
(AMC-IR-7-879(XIII); AD-443200)

The primary process under development for the complete passivation of planar silicon devices has been that of depositing various glass films over the surface. These surface-sealing silicate films are deposited from the vapor phase. The construction of a production plating system capable of large volumes of devices was completed and tested. Process aging test results are given for a number of different films under development. Additional work in the area of improved packaging is reported. Author

N65-19562# Boeing Scientific Research Labs., Seattle, Wash. Solid State Physics Lab.
REVIEW OF SOLID STATE PHYSICS LABORATORY, JULY–DECEMBER 1964
Hans Brunner Feb. 1965 20 p refs

Phase transformations in titanium alloys, microscopic strain analysis, new methods for calculation of electronic energies, scattered light photoelasticity, thermal effects in alloys resulting from small plastic strains, electron emission during metal fatigue, Mossbauer effect, X-ray absorption spectroscopy, cryogenic cooling by noncondensable gas injection, electronic structure of diboron tetrachlorides, optical and electron paramagnetic resonance of strontium titanate, and nuclear magnetic resonance in metal single crystals are discussed. A list of publications and a cumulative bibliography of the laboratory are included. E.E.B.

N65-19571# Boeing Scientific Research Labs., Seattle, Wash.
APPARATUS FOR THE DIRECT RECORDING OF ULTRASONIC ATTENUATION IN SOLIDS
R. L. Hagman, R. S. Krogstad, and R. W. Moss Jun. 1964 18 p refs
(DI-82-0357; AD-609037)

The technique and apparatus for measurement of acoustic losses in solids, primarily single crystals, at ultrasonic frequencies, are reported. The apparatus automatically records the acoustic attenuation as a function of some desired parameter. The circuitry for the apparatus and some typical results are included. Absolute accuracy for the apparatus is of the order of 5% with relative measurements of accuracy of 1% or better. Attenuations ranging from nearly zero to approximately 15 dB/cm can be measured. E.E.B.

N65-19582# International Business Machines Corp., Yorktown Heights, N. Y. Thomas J. Watson Research Center
INJECTION LASER STUDY Sixth Quarterly Report, 1 Sep.–30 Nov. 1964
K. Konnerth, F. F. Morehead, F. Stern, P. R. Wagner, and K. Weiser [1964] 36 p refs
(Contract DA-36-039-AMC-02349(E))
(Rept.-6; AD-458149)

An analysis of the temperature dependence of electroluminescence efficiency in CdTe and (Zn,Cd)Te diodes suggests a competition between a radiative transition to a center about 0.06 eV above the valence band and a nonradiative transition to a center near midgap. The efficiency increases with increasing injection level, when correction is made for heating during the current pulse. Preliminary results on heat treatment of GaAs in the presence of indium suggested that efficiencies might be increased. Further experiments have not confirmed this. A study of junction heating during a current pulse yielded consistent results from three different estimates of the junction temperature. For a diode at 77° K, the junction temperature was found to rise by about 35° K between the beginning of the pulse and the time, 18 μs later, when heating caused the laser to turn off. The laser in question had a threshold of 0.36 A, and was operated at 1 A. The temperature rise was estimated from the shift of the emission spectrum, from the temperature dependence of threshold current, and from consideration of the heat flow from the junction. Author

N65-19643# Laboratoire du Centre d'Etude de l'Energie Nucleaire, Mol (Belgium).
SOLID STATE NEUTRON DETECTOR
S. Amelinckx, R. de Coninck, M. Denayer, A. Givs, M. Heerschap et al Brussels, EURATOM, Nov. 1964 60 p refs
(Contract EURATOM-079-61-10 RDB)
(EURAEC-587; EUR-431-e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 70 Belg. Fr.

To develop an instrument for the detection of high neutron fluxes at high temperatures, using the SiC diodes, is the object of research. To obtain a fundamental understanding of the influence of the defects introduced upon fast neutron irradiation on the electronic behavior of SiC, radiation damage studies were also made on p- and n-type single crystals of SiC by means of resistivity and Hall effect measurements. Upon neutron bombardment p-type SiC is converted to n-type material. This indicates that the predominant defect is an effective donor state which is located at about 0.24 eV below the conduction band. The n-doped material remains of the same type after various periods of exposure. The relaxation processes of defects during heat treatment were examined by the isochronal pulse annealing technique. No measurable annealing occurs below 400° C. Photospectrometric measurements, however, reveal an annealing process starting at 300° C. Author

N65-19693*# Radio Corp. of America, Princeton, N.J. RCA Labs.
RADIATION DAMAGE IN SILICON Final Report Oct. 15, 1963–Oct. 15, 1964
N. Almeleh, B. Goldstein, and J. J. Wysocki [1964] 50 p refs
(Contract NAS5-3788)
(NASA-CR-57297) CFSTI: HC $2.00/MF $0.50

Electron paramagnetic resonance studies were made of the dominant paramagnetic defect produced in p-type silicon when bombarded by electrons at energies from 1 to 6.6 MeV. Diffusion length measurements were used to study the effects of impurities on radiation damage in silicon produced by electron bombardment. The diffusion of lithium throughout n-type silicon reduces its resistivity, yet the radiation damage resistance of surface barrier cells made from this material is typical of the prediffused material. Of all the impurities studied to date, only lithium has been found to give new and promising results. The interaction between lithium and radiation-induced defects in silicon was measured by electron paramagnetic resonance. Simultaneous measurements of both the lithium resonance and the damage resonance were made as functions of the lithium content and the bombarding electron flux at 6 MeV; an increase in one invariably produces a concomitant decrease in the other. Whether this involves the complexing of lithium with a damage center or merely the supplying of a donor electron from lithium to the damage center is not clear. For a clarification of this point, electron bombardments at much lower energies, about 1 MeV, are required. Author

N65-19704*# National Aeronautics and Space Administration, Washington, D. C.
MASS SPECTRA OF CERTAIN SOLID SUBSTANCES AND THEIR INTERPRETATION [MASS-SPEKTRY NEKOTORYKH TVERDYKH VESHCHESTV I IKH INTERPRETATSIYA]
M. S. Chupakhin and G. G. Glavin Mar. 1965 15 p refs Transl. into ENGLISH from Zh. Anal. Khim., (Moscow), v. 19, no. 7, 1964 p 821–829
(NASA-TT-F-9304) CFSTI: HC $1.00/MF $0.50

Experimental results obtained for the mass spectra of numerous solid substances, with a double-focusing mass spectrograph using a spark ion source, are given. Three mechanisms of the ion formation in the spark source are described—ionization by cathode sputtering, thermionic emission, and ionization by electron and ion collisions. The lines of atomic and molecular oxygen in the mass spectra are used for analyzing alloyed and unalloyed specimens of graphite, silicon, germanium, boron, arsenic, etc. Tabulated data on the results are given. Author

N65-19726# Atomics International, Canoga Park, Calif.
GRAIN BOUNDARY AND SURFACE INFLUENCE ON MECHANICAL BEHAVIOR OF REFRACTORY OXIDES—EXPERIMENTAL AND DEDUCTIVE EVIDENCE
S. C. Carniglia 1 Nov. 1964 89 p refs

A model for grain boundaries of MgO, Al_2O_3, and BeO is postulated, and tested against empirical elastic, plastic flow, and fracture data. Descriptions of the various atomiatic processes are given, and found consistent with experience. New conclusions are reached concerning the strengthening of ceramics. Author

N65-19734# Minnesota Univ., Minneapolis. Physical Electronics Research Lab.
RESEARCH IN PHYSICS OF ELECTRON EMISSION AND ELECTRON TUBE TECHNOLOGY Interim Report, Apr. 16–Oct. 15, 1964
D. E. Anderson, A. B. Laponsky, and W. T. Peria, ed. [1964] 317 p refs
(Contract AF 33(657)-10475)
(IR-4; AD-608149)

Further secondary emission characteristics of Al_2O_3 and MgO dynodes are reported. Studies of thin-film tunnel current diodes and triodes and of hot electron injection into such devices are reported. Several experiments relating to BaO, (BaSr)O and nickelate cathodes are described. Interpretations of the observed low energy electron diffraction patterns for Ge and CdF_2 are given. Further results of the surface studies of the Ge:Na and C:Na systems are presented. Recent results on bombardment-induced desorption of adsorbed gases and the motivation for a new experimental tube are presented. Experiments on electron emission from superconductors are described. Author

N65-19816# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SOLID STATE Quarterly Progress Report, 1 Apr.–30 Jun. 1964
Alan L. Mc Whorter and Peter E. Tannenwald 31 Jul. 1964 18 p ref
(Contract AF 19(628)-500)
(ESD-TDR-64-349; AD-603514) CFSTI: $1.00

Progress is reported in the research fields of solid state, lasers, materials, band structure and spectroscopy of solids, and magnetism and resonance. E.E.B.

N65-19830# Los Alamos Scientific Lab., N. Mex.
METALLOGRAPHIC AND ELECTRON MICROSCOPIC EXAMINATIONS OF FLUORIDE FILMS ON URANIA
W. P. Ellis and Dana L. Douglass 15 Feb. 1965 52 p refs
(Contract W-7405-ENG-36)
(LA-3183)

Metallographic and electron microscopic examinations revealed characteristic features of the interference films of uranium tetrafluoride formed on the flat surfaces of macrocrystalline uranium dioxide by reaction with gaseous anhydrous hydrogen fluoride. At reaction temperatures in the interval 200°–300° C the product films are isotropic and uniform in color although the surface itself has topographical details. Above 300° C there is a progressive formation of blemishes with degradation beginning first at roughness sites in the substrate and apparently spreading to include the entire surface. For reactions at 400° C and below there are no specific features in the replicas to correlate with the blemishes. All of the structures seen in the replicas of the reacted specimens are also seen in replicas of the substrate. At 463° C, however, the film is covered with ruptures visible with the electron microscope. Author

N65-19863*# General Dynamics/Electronics, Rochester, N. Y. Research Dept.
LASER MODULATION AT THE ATOMIC LEVEL Monthly Report No. 6, Dec. 1964
E. G. Brock, F. C. Unterleitner, Y. C. Kiang, and J. F. Stephany 10 Jan. 1965 13 p refs
(Contract NASw-1008)
(NASA-CR-57464) CFSTI: HC $1.00/MF $0.50

The frequency shift of ruby laser emission under inhomogeneous magnetic fields was measured by time resolved spectroscopy. The 0° ruby shows a frequency shift of 0.32 cm^{-1} with 5 kG peak field, while 90° ruby emission shifts +0.25 cm^{-1} for the same field strength. The influence of crystal field splitting on the YAG:Nd^{3+} laser transition Zeeman splitting is discussed. The possibility of confirming nearby tetragonal site symmetry is also discussed. Author

N65-19867*# Illinois Univ., Urbana. Dept. of Physics
AN EXPERIMENTAL INVESTIGATION OF RADIATION EFFECTS IN SEMICONDUCTORS Semiannual Status Report, 1 Jul.–31 Dec. 1964
W. Dale Compton [1964] 13 p refs
(Grant NsG-228-62)
(NASA-CR-57471) CFSTI: HC $1.00/MF $0.50

The Si-A, Si-E, and Si-J centers of previously established silicon defects were studied. The silicon-A center consists of a substitutional oxygen atom, and the Si-E center consists of a silicon vacancy trapped next to a substitutional phosphorous impurity. The Si-J center describes the prominent defect in p-type silicon, a divacancy found in two states dependent on the proximity of the Fermi level to the valence or to the conduction band. Each of these defects can act as recombination centers, and thereby influence the lifetime of minority carriers that are released in the crystal by a short pulse of light. After solving the problem of necessary surface treatment of the samples, the recombination luminescence of a sample of one ohm-cm p-type silicon was determined. Information on the radiation-induced changes in conduction near the liquid helium band and its application to the proposed models of impurity conduction is discussed. E.P.V.

N65-19935# Nuklearni Institut Jozef Stefan, Ljubljana (Yugoslavia).
DIELECTRIC PROPERTIES OF $NaH_3(SeO_3)_2$ AND $NaD_3(SeO_3)_2$ SINGLE CRYSTALS
R. Blinc, A. Jovanovic, A. Levsik, and A. Prelesnik Sep. 1964 13 p refs Submitted for Publication
(NIJS-R-438)

Both polarization and dielectric constant measurements at 1 kc/s, 2.10^5 kc/s and 8.4×10^3 Mc/s show that $NaH_3(SeO_3)_2$ undergoes a second-order ferroelectric transition at $T_c = -80°$ C, whereas $NaD_3(SeO_3)_2$ makes a transition to an apparently antiferroelectric state at $T_c = -2.5°$ C. It is believed to be the first time that such drastic changes in the general dielectric behavior, Curie–Weiss constant, and type of the transition were observed on deuteration. The antiferroelectric state in $NaD_3(SeO_3)_2$ seems to be very close in energy to a field-induced ferroelectric one, the difference in the free energy being of the order of 1 cal/mole a few degrees below the transition temperature. Author

N65-19939# American Meteorological Society, Boston, Mass.
STUDIES ON THE THEORY OF CRYSTAL GROWTH AND PHASE TRANSITIONS [ISSLEDOVANIIA PO TEORII ROSTA KRISTALLOV I FAZOVYM PEREKHODAM]
B. Ia. Liubov Bedford, Mass., AFCRL, Jul. 1964 10 p Transl. into ENGLISH from Vestn. Akad. Nauk (Moscow), no. 1, 1962 p 134–136
(Contract AF 19(628)-3880)
(T-R-446; AD-609171)

The main theme of the conference was the problem of crystal growth from the liquid phase. Most of the work reported was centered around the so-called theory of two-dimensional nucleation. E.P.V.

N65-19963# Motorola, Inc., Phoenix, Ariz. Semiconductor Products Div.
RESEARCH AND DEVELOPMENT FOR SEMICONDUCTOR SURFACE CONTROL AND STABILIZATION Scientific Report No. 2, Sep.–Nov. 1964
K. D. Kang, B. Van Pul, and J. Adamic 14 Nov. 1964 146 p refs
(Contract AF 19(628)-3808)
(AFCRL-65-27; AD-612705)

Work was performed in the following areas: metal oxide semiconductor (insulated gate) field effect transistor instability and degradation, the behavior of thermally grown silicon oxide passivating layers, the discovery of interface dislocations in passivated silicon structures, the effect of boron and phosphorus glasses on the distribution of gold in silicon, the effect of water processing on gold distribution near silicon–silicon dioxide interfaces, the comparison of glasses on passivated transistors manufactured by different companies, and germanium planar transistor investigation. Author

N65-19966# Stanford Univ., Calif. Solid-State Electronics Lab.
ANALYTICAL STUDY OF ZINC-DIFFUSION IN GALLIUM ARSENIDE AND THE ELECTRICAL PROPERTIES OF THE RESULTING DIFFUSED LAYERS Technical Report No. 5103-1
Rajendra Mehta Jun. 1964 71 p refs
(Contract DA-31-124-ARO(D)-155; AF 33(616)-7726)
(SEL-64-062; AROD-2895-15; AD-610262)

This study undertakes to establish the relationship of anomalous profiles to the diffusion equation; to calculate the relationship among the parameters of the zinc-diffused layers, and to measure the resistivity of GaAs as a function of zinc concentration. Concentration profiles for various surface concentrations of zinc are obtained by the solution of the diffusion equation with a diffusion coefficient that is a cubic polynomial in zinc concentration. The polynomial for the diffusion coefficient is determined by matching computer solutions with experimentally measured profiles for two different surface concentrations. Comparison of these diffusion coefficients with those obtained from isoconcentration diffusion experiments shows excellent agreement for zinc concentrations less than 5×10^{19} cm^{-3}. Beyond this concentration however, the polynomial gives larger values for diffusion coefficients than those found by experiment and, as a result, the calculated profiles agree with experimentally measured ones only up to surface concentration of 5.0×10^{19} cm^{-3}. Author

N65-19968# Zenith Radio Corp., Chicago, Ill. Research Dept.
INFRARED STIMULABLE PHOSPOR STUDIES Quarterly Technical Report, 30 Jul.–31 Oct. 1964
Stanley Polick, Gil Kaufman, Wayne Hadley, and Herbert N. Hersh [1964] 27 p
(Contract DA-44-009-AMC-455(T))
(QTR-3; AD-458390)

Further studies were made of the phosphorescence and X-ray charging process in KI:Tl single crystals. The levels of charging and phosphorescence are important limiting factors in the use of this material for detection of very low level infrared signals. Single crystals of KI:Tl having thallium concentrations of 10^{-1} mole % have been prepared. Relative measurements indicate that charging and stimulation efficiencies are improved at the higher dopant levels. The temperature dependence of IR stimulability has been investigated for a KCl:Tl single crystal. This material maintains stimulability up to about 250° K. Its luminescence behavior appears to parallel that of KI:Tl in many respects. Author

N65-19979# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Solid State Physics Lab.
A STUDY OF THE COEFFICIENTS OF THE SPIN PERMUTATION OPERATORS IN THE EFFECTIVE SPIN HAMILTONIAN
Thomas C. Collins Nov. 1964 117 p refs
(ARL-65-14; AD-611834)

The Heisenberg Spin Hamiltonian is derived for a system of N electrons and a set of fixed ion cores with the Hamiltonian spinfree. The wavefunction has the form $\psi = \hat{A}F\,\theta$, where $\hat{A}$ is the antisymmetrizer, F, a function of coordinate space is required to have no symmetry, and θ is a function of the spin coordinates. By the use of the representation of the permutation group, the coefficients of the spin permutation operators are written as linear combinations of the S_n group functions. The formulism is then applied to 3- and 6- electron systems, where the dependence of the S_n group upon lattice spacing is studied. Author

N65-19994# Tyco Labs., Inc., Waltham, Mass.
STUDY OF SURFACE STATES IN SEMICONDUCTORS Interim Report, 5 Jul.–4 Sep. 1964
G. Rupprecht and P. H. Smakula Griffiss AFB, N.Y., RADC, Feb. 1965 22 p refs
(Contract AF 30(602)-3157)
(RADC-TDR-64-485; AD-612051)

Silicon surfaces have been studied, using the pulsed field effect, which were prepared by three means: untreated, thermal oxide grown in air (no H_2O), and anodically oxidized, the oxide being grown to various thicknesses. On 10Ω-cm n-type silicon, samples oxidized to less than 500 Å showed a surface state 0.54 eV below the conduction band. Oxide thicknesses greater than this showed a resulting state 0.64 eV below the conduction band. At the same time, the capture cross section increased with oxide thickness. Preliminary results indicate that the density of surface states is inversely proportional to the dislocation density. Author

N65-19995# Rome Air Development Center, Griffiss AFB, N.Y. Research and Technology Div.
ACOUSTIC PROPAGATION AT MICROWAVE FREQUENCIES
W. F. Gavin, Jr. and J. R. Miller Dec. 1964 41 p refs
(RADC-TR-64-564; AD-611830)

Techniques for the generation, propagation, and detection of sound at microwave frequencies were investigated. Transmission and reflection experiments with quartz crystals are discussed with the design of a microwave delay line as the final product. Various limitations for the system were discovered, and methods of overcoming them were studied. Experiments with zinc oxide transducers were performed in an attempt to overcome the high insertion losses in quartz crystals. Propagation effects in various crystal geometrics were also studied. Author

N65-20008# Raytheon Co., Waltham, Mass. Research Div.
HIGH FREQUENCY TUNNEL DEVICE STUDY Fourth Quarterly Report
S. R. Steele and A. Starr Griffiss AFB, N.Y., RADC, Feb. 1965 26 p refs
(Contract AF 30(602)-3249)
(RADC-TR-64-586; AD-612059)

The most immediate problem limiting the practical application of tunnel devices for low noise receiver applications has been the short lifetimes heretofore obtained. Low temperature operation is desirable to achieve low noise, and seems to be highly beneficial from the standpoint of life. The lifetimes of $Al:Al_2O_3:Au$ tunneling structures are extended by factors ranging from 10 to 100 when operation is carried out at 200° K as compared with operation at room temperature. The large increase in sandwich current and emission into vacuum in the early stages of life of devices tested at constant voltage appears to be due to change in the barrier, probably because of ion migration. The capacitance increases at a similar rate. Both effects are slowed by operation at reduced temperatures. The large increase in sandwich current observed near the end of life may be due to a runaway condition related to an apparent negative resistance, which develops at voltages below the normal operating point. The change in the slope of the V-J characteristics near the end of life may be due to the development of conducting channels extending partially through the insulating film. Both of these effects are marked at low temperatures. Author

N65-20026# General Telephone and Electronics Labs., Inc., Bayside, N.Y.
LOW VOLTAGE DC LUMINESCENCE Final Report, Mar. 26, 1963–Mar. 25, 1964
M. S. Wasserman and R. N. Summergrad Griffiss AFB, N.Y., RADC, Dec. 1964 44 p refs
(Contract AF 30(602)-2997)
(RADC-TDR-64-276; AD-611166)

Injection electroluminescence in p-n junctions was chosen as the most promising approach to the development of a high brightness, high-efficiency low-voltage dc injection electroluminescent light source for display-device applications. The compounds GaP, AlAs, AlP, their solid solutions, and their alloys with GaAs, were studied, based upon considerations of forbidden energy bandgap and a carrier mobility. The most important results of this work are the preparation of polycrystalline AlAs of relatively high purity, and the use of this material to prepare single crystal epitaxial layers whose major constituent is AlAs. Epitaxial growth of AlAs layers requires temperatures above 1100° C. These temperatures were obtained without introducing interference from competing reactions with the container by adapting a close-spacing procedure in which the source material and the substrate are separated by approximately 0.020 inch. This procedure also provides higher crystal growth rates than those obtained with conventional sealed-tube methods. Author

N65-20029# General Electric Co., Schenectady, N.Y. Research Lab.
RESEARCH TO INVESTIGATE THE MICROSTRUCTURE OF THE INTERNAL MAGNETIC FIELD IN SELECTED MAGNETIC MATERIALS Progress Report No. 3, Aug. 10–Nov. 10, 1964
C. D. Graham, Jr. and I. S. Jacobs Nov. 1964 11 p refs
(Contract AF 33(615)-1490)
(Rept.-64-GC-0295M; AD-610196)

Magnetization measurements were made on a single-crystal disk containing a significant volume of platelike or needlelike phase, which was tentatively identified as Gd_2O_3. The Curie temperature was determined graphically for the case of field parallel to crystal axis, and the results compared to previously determined values. Torque measurements were also begun. Information on the antiferromagnetic behavior of $FeCl_2$ was obtained for comparison with a previous study of $FeBr_2$, and current resonance studies of the chloride. Magnetization of a cylindrical sample as a function of applied external field was established, as well as the critical internal field for the metamagnetic transition as a function of temperature. E.P.V.

N65-20067# Pennsylvania State Univ., University Park.
EQUILIBRIUM VALUES FOR HIGH PRESSURE TRANSITIONS OF GERMANIUM AND A NEW HIGH PRESSURE FORM OF GERMANIUM

Carl H. Bates, Frank Dachille, and Rustum Roy Aug. 1964 19 p refs
(Contract Nonr-656(20))
(TR-19; AD-612540)

Very long runs, by superpressure standards, of up to 3 weeks near 100 kbars demonstrated the extreme sluggishness of some transitions in Ge and other semiconductor systems. This raises serious questions about the significance of the pressure values attached to various transitions and the reality of some phase diagrams based on discontinuities observed in optical or electrical properties in an essentially dynamic system. The successful recovery of high pressure phases in semiconductor systems by quenching to, and working at, dry ice temperatures was demonstrated. In the system Ge, a new high pressure polymorph, Ge-IV, was synthesized above 110 kbars with a bcc structure analogous to Si. The equilibrium transformation pressure for the reaction Ge-I⇌Ge-III(bct) was revised downward from about 120 kbars to 40 kbars at 30° C. The transition from the Ge-I diamond structure to the Ge-II white tin structure is always metastable. Author

N65-20070# Bell Telephone Labs., Inc., Whippany, N. J.
PROPERTIES OF FERRIMAGNETIC MATERIALS FOR MICROWAVE APPLICATIONS
A. S. Boxer, J. F. Ollom, and R. F. Rauchmiller Jul. 1964 540 p refs
(Contract AF 33(657)-8439)
(ML-TDR-64-224; AD-612274)

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1. THE PHYSICS OF FERRIMAGNETIC MATERIALS p 1–52 refs
2. GARNETS p 53–256 refs
3. SPINEL FERRITES p 257–446 refs
4. HEXAGONAL FERRITES p 447–518 refs

N65-20102# Naval Ordnance Test Station, China Lake, Calif. Research Dept.
EXO-ELECTRON EMISSION DUE TO ULTRASONIC IRRADIATION
J. A. M. Langenecker and D. B. Ray Dec. 1964 5 p refs Repr. from J. Appl. Phys., v. 35, no. 9, Sep. 1964 p 2586–2588
(NAVWEPS-8672; NOTS-TP-3721; AD-611888)

The emission of electrons from metals can be excited through a variety of treatments and stimulated by thermal energy, as shown only recently by high-intensity ultrasound. Investigations were carried out on disks of 99.999% pure aluminum and aluminum 6061, exposed to acoustic irradiation up to 100 W/cm^2 at kc/sec. The peak emission at certain intensity levels of the acoustic field is presented, compared with emission from thermal stimulation, and discussed from the viewpoint of acoustic activation of lattice defects in metal crystals. Author

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N65-18652# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REFINING OF CRUDES AND GAS: GASOLINES FOR AIRCRAFT ENGINES
Kazimierz Kachlik 2 Feb. 1965 14 p Transl. into ENGLISH from Wiadomosci Naftowe (Warsaw), v. 83, no. 9, 1962 p 204–208
(FTD-TT-64-511/1+2; AD-456870)

Composition, additives, volatility, stability, antiknock properties, and performance of aviation gasoline is discussed. The causes of vapor lock are presented with data showing the dependence on temperature and barometric pressure. The change in performance numbers with addition of tetraethyl lead is approximated. E.E.B.

N65-18653 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
REDUCTION IN LIQUID OXYGEN LOSSES IN TANKS OF SOVIET AVIATION
22 Dec. 1964 4 p Transl. into ENGLISH from Wojskowy Przeglad Lotniczy (Warsaw), no. 11, 1963 p 69
(FTD-TT-764/1+2; AD-455486)

In the past liquid oxygen has been stored in special tanks insulated by powdered magnesium. Evaporation as high as 10%/day is reported. Recently, vacuum-powder insulation has attained a tenfold reduction in such losses. The oxygen tank consists of a hermetically sealed vessel with outer and inner shielding. The space between the vessel and the shielding is filled with an insulation powder of the aerosol type, and in addition, a vacuum is created with a pressure of 0.1 to 0.5 mm Hg remaining. After the tank is filled with liquid oxygen, this pressure falls to 0.01 mm Hg due to absorption of the cooled gas on the inner surface. Further, improvements are expected with an insulation known as screen-vacuum insulation. E.E.B.

N65-18858# McGill Univ., Montreal (Quebec). Space Research Inst.
BALLISTIC DEVELOPMENT TESTING OF M8-M PROPELLANT IN THE 16" BARBADOS GUN, NOVEMBER 1964
F. W. Eyre Nov. 1964 15 p refs
(Contracts DA-20-018-ORD-24562; DA-20-018-AMC-0190R)
(SRI-H-R-1; AD-452862)

Three test shots were conducted with charges of 650, 781, and 849 lb of M8M propellant with a 0.218-inch web, and a nominal test slug weight of 400 lb. The gun geometry is being improved as part of the overall program and the new chamber configuration—3 feet longer than the original—was simulated, but in the absence of the new muzzle extension (21-feet total length), considerable penalty was paid in muzzle velocity. The propellant web was close to optimum for the chamber size, projectile weight and proposed total shot travel. Based upon the data collected, velocities of 6200 ft/sec ±200 ft/sec will be achieved with 18-foot increased shot travel at a Breech pressure of 58 000 psi. Author

N65-19095# California Inst. of Tech., Pasadena. W. M. Keck Lab. of Engineering Materials
A RESEARCH PROGRAM ON SOLID PROPELLANT PHYSICAL BEHAVIOR Quarterly Report No. 4, 1 Aug.–30 Nov. 1964
M. L. Williams Dec. 1964 7 p refs
(Contract AF 04(611)-9572)
(MATSCIT-PS-64-10; AD-611393)

The failure behavior of the gum rubber vulcanizates SBR, EPR, and IR was investigated (1) by a variety of mixing and curing processes, and (2) through tensile testing at +78° and −40° F. Results obtained on cured SBR gum pulled at 75° F for 2 in./min are presented and show optimum resilience at approximately 10% plasticizer level and a cure level of 0.5%. Thermoelastic studies on IR gum systems were used to evaluate the

nature of the internal energy distribution to the stress–strain behavior. A new equation of state for the prediction of mechanical behavior has been proposed suggesting that the extension ratio at break is related to the number of statistical segments in the chain by the relation $\lambda_b = (3n)^{1/2}$. The selection of a polymer standard eliminated EPR and butyl methacrylate on the basis of poor optical properties. Research in structural analysis pertaining to solid rocket motors continued with work on the mechanics of fracture as might occur in motor cases. Special emphasis was put on the effects of plasticity and plate thickness. G.G.

N65-19275*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EFFECT OF LIQUID NITROGEN DILUTION ON LOX IMPACT SENSITIVITY
C. F. Key and J. B. Gayle 15 Feb 1965 31 p refs
(NASA-TM-X-53208) CFSTI: HC $2.00/MF $0.50

An experimental investigation was carried out to study the decrease in reactivity of materials with liquid oxygen (LOX) caused by dilution of the LOX with liquid nitrogen (LN_2). A wide range of materials was selected for testing, each of which previously had been shown sensitive to impact in LOX. Tests were made with the ABMA LOX Impact Tester using LOX/LN_2 mixtures ranging in concentration from 20% LOX in LN_2 to pure LOX. The results showed that relatively large proportions of LN_2 were required to effect an appreciable decrease in reactivity; however, all materials tested were insensitive to impact at 10 kg-m in liquid air. Author

N65-19520# Army Engineer Research and Development Labs., Fort Belvoir, Va.
PROJECT BEARS (BACTERIOLOGICAL EFFECTS AIRCRAFT REFUELING SYSTEMS)
Richard R. Rogowski and Robert N. Brown 9 Oct. 1964 147 p refs
(TR-1789-TR; AD-609527)

Investigations were conducted to determine characteristics and growth rates of microbial contaminants in aircraft fuels; to learn the effects of such contaminants on the performance of filter-separators and other fueling system components; and to ascertain the effects of certain additives and biocides on microbial growth rates and fuel properties. It was found that deleterious microbial growths do not occur in certain fuels in the presence or absence of water. Filter-separators afford a high degree of microbial decontamination because they continue to remove free water from the fuel in the presence of microbial matter, and the bulk of this contamination is associated with the free water phase. E.E.B.

N65-19576# Stanford Research Inst., Menlo Park, Calif.
RESEARCH ON UNSTABLE COMBUSTION IN SOLID PROPELLANT ROCKETS Annual Report, Jan. 1–Dec. 31, 1964
L. A. Dickinson, E. L. Capener, and R. J. Kier 13 Jan. 1965 67 p refs
(Contract AF 49(638)-1367; ARPA Order 317)
(AD-612178)

Initiation of axial combusion instability in an experimental combustor, 40 inches long by 50 inches i.d., containing a radial burning grain, was studied utilizing a wide variety of composite propellants. Where instability occurred, a correlation was found between the threshold pressure at which instability was first observed and propellant ballistic parameters, notably the linear burning rate. Fast burning propellants, containing either a catalyst or potassium perchlorate, did not sustain axial mode combustion instability. Transverse instability was observed for most nonaluminized propellants in pressure regimes where they were stable to axial combustion instability. An explanation of combustion stability criteria has been sought in terms of either mixing processes within a granular diffusion flame or a thermal explosion process. The granular diffusion flame concept appears thus far to be the more promising explanation; it predicts the stability trends observed in large solid-propellant rocket motors. Author

N65-19623# Malaker Labs., Inc., High Bridge, N. J.
KINETIC STUDY OF ROCKET EXHAUST GASES: STUDY OF RADIATION EMITTED BY MODIFIED AND UNMODIFIED PROPELLANT SYSTEM Progress Report, Quarter Ending Jan. 1, 1965
[1965] 7 p
(Contract DA-39-069-ORD-2918)
(PR-11; AD-609600)

Direct radiation from propellants was compared with radiation from a tungsten strip lamp. During propellant combustion, radiation was monitored by a photovoltaic cell through a Wratten Number 29 glass filter in the wavelength range of 6000 to 7000 Å. Data are presented. The results indicated a monotonic increase of radiation from the unmodified propellant formulation, but a distinct periodic increase and decrease occurred through the burning rate plateau associated with the modified propellant material. E.E.B.

N65-19703*# National Aeronautics and Space Administration, Washington, D. C.
HIGH ENERGY PROPELLANTS—A CONTINUING BIBLIOGRAPHY
Mar. 1965 104 p
(NASA-SP-7002(01)) CFSTI: HC $1.75/MF $0.75

A selection of annotated references to unclassified reports and journal articles is presented. Prime emphasis is given to references on solid, liquid, and hybrid propellants and oxidizers. Also, extensive coverage of related topics, such as propellant handling and storage, combustion characteristics, toxicity, hazards, and safety measures, is provided. R.W.H.

N65-19787# Rohm and Haas Co., Huntsville, Ala. Redstone Arsenal Research Div.
APPLICATIONS OF MICROWAVES IN THE NONDESTRUCTIVE TESTING OF SOLID PROPELLANTS
W. W. Brandon, Jr. 2 Nov. 1964 61 p refs
(Contract DA-01-021-ORD-12341(Z))
(S-53; AD-609982)

The feasibility of using microwaves to test various properties of solid propellants was examined experimentally. Power employed was less than 0.1 W at frequencies between 8 and 24 Gc. Results with dummy propellant formulations were evaluated in terms of signal attenuation. Attenuation in a polymer-filled waveguide decreased during polymerization by a factor of from 2 to 10 depending upon the material tested. Changes as small as 0.1 decibel per centimeter of test sample thickness were detectable. Propellant–propellant interfaces between slabs were found to produce detectable attenuation by reflection only at high angles of incidence with the electric field of the test signal perpendicular to the plane of incidence. Gross defects were clearly evident in a small dummy propellant charge having low specific attenuation and contained in a nonmetallic case. Author

N65-20006# Little (Arthur D.), Inc., Cambridge, Mass.
A STUDY OF THE HAZARDS IN STORAGE AND HANDLING OF LIQUID HYDROGEN
L. H. Cassutt, F. E. Maddocks, and W. A. Sawyer [1958] 15 p refs
(Contract AF 18(600)-1687)
(AD-607834)

The potential hazards of liquid hydrogen, its detonation in free space from gross spillage, the deflagration effects of liquid hydrogen, the radiation effects on personnel from liquid hydrogen flames, the possibility of ignition of a vapor cloud formed after large-scale spillage, and the detonation of liquid hydrogen in the presence of solid air mixtures were investigated by experiments. It was concluded that liquid hydrogen is much safer to handle than many other missile propellants. When accidentally mixed with air under unconfined conditions, it does not detonate and radiation effects of any fire are less than those of more conventional fuels. Its low initiation energy and wide flammability, however, make ignition of any vapor cloud more likely and, for that reason, more care must be taken to remove all potential sources from an area where liquid hydrogen is stored or handled. E.E.B.

N65-20062# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md. Chemical Propulsion Information Agency
PROCEEDINGS OF THE NINTH MEETING OF THE ICRPG WORKING GROUP ON DESIGN AUTOMATION
Aug. 1964 52 p refs Meeting Held at Thiokol Chem. Corp., Elkton, Md., 16–17 Jul. 1964
(Contract NOw-62-0604-c)
(CPIA-Publ.-55; AD-445065)

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N65-20063 Aerojet-General Corp., Sacramento, Calif.
THE INTEGRATED DESIGN PROGRAM
Richard V. Alexander *In* APL Proc. of the 9th Meeting of the ICRPG Working Group on Design Automation Aug. 1964 p 5–21 refs (See N65-20062 09-27)
(Contract DA-04-200-ORD-1305)

The integrated design program resulted in the successful coupling together of previously independent computer programs for conceptual solid-rocket design, design optimization, and grain design. The resultant computer program provides conceptual solid-rocket designs which are more realistic in that grain designs and resultant ballistic performance are compatible with the hardware estimates. In the past, motor designs were parallel efforts which required inputs from one another. The end results were usually compromised because of lack of adequate crossfeed of information and lack of sufficient time for analyses. Motor and grain designs are now a sequential effort with crossfeed of information and elapsed time rarely a problem. Author

N65-20077# Coordinating Research Council, Inc., New York. Ad Hoc Group on Aviation Fuel Safety
AVIATION FUEL SAFETY
Feb. 1965 78 p refs

After reviewing available information, the consensus is that, while there are differences among the fuels, adoption of a single type of aviation turbine fuel by the entire industry would not significantly improve the overall excellent safety record of commercial aviation, and that safety is more a function of equipment design, proper handling techniques, and rigorous precautions than of the particular fuel type employed. Author

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N65-18728 Joint Publications Research Service, Washington, D. C.
PRODUCTION, PROPERTIES, AND PROSPECTS OF UTILIZATION OF SELENIDES OF THE RARE EARTH METALS
V. A. Obolonchik and G. V. Lashkarev *In its* Probl. of the Theory and Use of Rare Earth Metals 23 Feb. 1965 p 217–226 refs (See N65-18701 09-17) CFSTI: $7.00

Results of two methods of producing selenides of rare earth metals (REM) are reported. In the first method, the selenides were formed directly from the REM oxides by heating a fine mixture of them with selenium, as well as by the action of hydrogen selenide on the oxide. In the second method, the selenides were produced by the direct action of hydrogen selenide on the metal. Data include (1) chemical compositions at various temperature for reaction of cerium dioxide and hydrogen selenide, and for cerium dioxide and selenium, (2) physical properties of various REM selenides, and (3) effective magnetic moments of various REM and their selenides. J.M.D.

N65-18819* National Aeronautics and Space Administration, Washington, D. C.
DEVELOPMENT OF LAMBDA-735-TYPE ROCKET ENGINE
R. Akiba *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 121–128 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Several Lambda-735 rocket engines are described as possible boosters for the L-2 rocket in the Japanese space program. These four-nozzle engines were ground fired to evaluate combustion stability. Measurements include (1) internal pressure and vibration, (2) thrust force, (3) temperature at nozzle, and (4) stress. It was concluded that the Lambda-type engine can be used as an L-2 booster. J.M.D.

N65-19046# Saab Aircraft Co., Linkoping (Sweden).
GENERAL PERFORMANCE INVESTIGATION OF TURBOJET ENGINES
Bengt Ahren Aug. 1964 43 p
(SAAB-TN-52)

The investigation covers pure turbojet engines without reheat and with reheat at 2000° K in the Mach number range up to 3.0. The main engine parameters varied are compressor pressure ratio—ranging between 4 and 15, compressor type, single- or double-spool, and turbine inlet temperature—800° to 1200° C. The performance calculations at different flight conditions are based on nondimensional functions for gross thrust, airflow, and fuel flow which were first determined. The basic thermodynamic relations for those functions are dealt with, and it is shown that nondimensional gross thrust, airflow, and fuel flow can be uniquely defined by a single temperature ratio parameter which expresses the relation between turbine and compressor inlet temperatures, and for various values of which nondimensional functions are tabulated. A number of typical performance curves are presented, showing maximum thrust per frontal area, and specific fuel consumption versus flight Mach number, and the effect of the main parameters is discussed. Author

N65-19073# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON QUESTION OF COMPARISON OF RADIAL CENTRIPETAL AND AXIAL STAGES OF TURBINES
P. V. Orekhov and V. P. Gavrikov 26 Jan. 1965 23 p refs Transl. into ENGLISH from Tr. Inst. Dvigateley, Akad. Nauk SSSR (Moscow), no. 6, 1962 p 61–75
(FTD-MT-64-261; AD-611086)

Heat drop and efficiency of axial and radial stages of turbines are analyzed. Radial centripetal turbines (RCT) with efficiencies of 86% are reported. It is concluded that it is possible to obtain efficiencies in the radial stage which approach those obtained in the axial stage. In several cases, the heat drop in one stage of the radial centripetal turbine exceeded that of the axial stage. Additionally, the guide vane apparatus for the RCT is simpler to build. E.E.B.

N65-19192# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIR-BREATHING JET ENGINES
G. Yu. Mazing 3 Dec. 1964 77 p refs Transl. into ENGLISH of the book "Vozdushno-Reaktivnyye Dvigateli" Moscow, Voyennoye Izd. Min. Oborony SSSR, 1961 p 1–72
(FTD-MT-64-225; AD-609158)

The basic principles and applications for air-breathing jet engines without compressors, such as ramjets and pulsejets, and for compressor-type air-breathing jet engines are presented. It is shown that the operating conditions of an air-breathing jet engine depend to a large extent on the relation of the speed of flight to the speed of sound. Emphasis is placed on the ramjet engine and its use in rocket technology, and questions in connection with diffuser, combustion chamber, and nozzle are discussed. A brief historical survey of air-breathing jet engines and the prospects for their future development are given. G.G.

N65-19502*# General Electric Co., Cincinnati, Ohio. Missile and Space Div.
THE PLASMA SEPARATOR ION ENGINE Summary Report, Apr. 1, 1963–Jun. 30, 1964
B. A. Free, W. N. Neiman, and G. P. Kerr, Jr. 15 Mar. 1965 373 p refs
(Contract NAS3-3561)
(NASA-CR-54240) CFSTI: HC $7.00/MF $2.00

The inherent technical feasibility of the plasma separator ion engine has been demonstrated experimentally both in separate engine component development programs and in a final 50-hour engine run. Peak ion source performance has been established well above that of any other source under development, at levels of ionization above 99% and power costs below 100 electron volts/ion. An engine run of 56-hours total duration was made with an overall thrustor efficiency of 83.1% at an engine specific impulse of 6360 seconds. Separate component performance has indicated that a thrustor efficiency of 86.5% is obtainable. Capabilities of the plasma separator engine operating at this level are included. Theoretical information presented shows that the low ion generation power required in the engine results in superior thrustor efficiency in the low specific impulse region. E.E.B.

N65-19740# Thiokol Chemical Corp., Huntsville, Ala. Alpha Div.
TX-33-39 (MODIFIED) MOTOR NUMBER 387, INTEGRAL MANDREL TEST, STATIC TESTED 19 JANUARY 1965 Preliminary Test Report
J. T. Darwin 10 Feb. 1965 12 p

A modified TX-33-39 motor underwent static firing to demonstrate the feasibility of the integral foamed mandrel concept in large rocket motors. Ignition by three pyrocores interlaced within the mandrel provided harmless disintegration and ejection of the mandrel at ignition. Visual inspection of the motor 5 minutes after testing did not find any hot spots on the motor case and the nozzle erosion appeared to be normal. A data performance sheet is attached. G.G.

N65-19814# Federal Aviation Agency, Washington, D. C. Systems Research and Development Service
ANALYSIS OF ENGINE EXHAUST SYSTEM FAILURES IN GENERAL AVIATION AIRCRAFT
Gerald R. Slusher Sep. 1964 36 p
(FAA-ADS-29)

A study of the records of engine exhaust system malfunctions, and an analysis of the resultant incidents and accidents were made to determine the extent of the inflight hazards involving carbon monoxide poisoning, fire, power loss, etc., in general aviation aircraft of the single engine type. The failure information, related to each of the aforementioned hazards for the time period 1958 through 1962, was analyzed and presented in frequency distribution form. Reported incidence of the presence in the cabin of exhaust gases and the number of documented illnesses and fatalities attributed to carbon monoxide poisoning were presented. Included was the incidence of fires and engine power losses resulting from exhaust system defects. Exhaust system failure information concerning specific aircraft models was studied and presented as a function of operating time. The average operation time for exhaust system failure was found to be a function of the number of a specific aircraft model certificated, or a function of the length of time that the aircraft was in production. The exhaust systems of newer aircraft fail at a markedly higher rate than the exhaust system of older aircraft. Author

N65-19829# Aerojet-General Corp., Sacramento, Calif.
WEAPON SYSTEM 107A-2: PRODUCT ENGINEERING PROGRAM, COATED METALLIC THRUST CHAMBERS EXPANDABLE NOZZLES, COMBUSTION INSTABILITY SCALING CONCEPTS, ABLATIVE THRUST CHAMBERS Monthly Progress Report, 1–31 Jan. 1964
15 Feb. 1964 50 p
(Contract AF 04(694)-212/SA3)
(Rept.-212/SA3-2.2-M-6; AD-430285)

Chamber three has been coated and delivered to the test area. The base layers were graduated nichrome–zirconia with a topcoat of tungsten coated zirconia. Also, the 5% film-cooling injector was delivered to the test area. Results of the thermal shock tests are summarized. The X-ray diffraction, X-ray fluorescence, and metallographic measurements are included.
E.E.B.

N65-20017# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERE WILL BE NO PHOTON ROCKET
V. Smilga 25 Feb. 1965 13 p Transl. into ENGLISH from Znanie Sila (Moscow), no. 7, 1960 p 31–33 Revision to FTD-TT-64-690/1+2+4, 4 Dec. 1964
(FTD-TT-64-690/1+2+4; AD-611872)

The possibility of creating rockets capable of traveling 4.2 light years to the nearest star to our solar system is discussed and found unfeasible. The total mass of a nuclear rocket estimated at 10 times 100 000 tons at a speed of 100 000 kilometers per second would require $2.4 \cdot 10^{22}$ ergs of energy for every kilogram of rocket mass. Atomic fuel does not generate enough energy to reach accelerations of 10 m/sec^2 to attain the velocity needed to fly around the galaxy within the period of a human lifetime. Through-feed photon rockets would not drag enough interstellar substance in from the cosmos at velocities up to 200 000 kilometers per second. It is concluded that the stars cannot be reached with nuclear fuels or with any photon rockets.
G.G.

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N65-18844* National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF COSMIC RADIATION BY KAPPA 8, NO. 11 ROCKET
Yukio Miyazaki, Kazu Takeuchi, Imai Takashi, Tadayoshi Yoshizawa, Kozo Otsuka et al *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 306–315 (See N65-18801 09-31)
CFSTI: HC $7.00/MF $2.25

This experiment was planned in order to obtain the effects of various surrounding materials on the radiation counting rate up to the altitude of 200 km. The single counts as a function of time from all three counters showed nearly the same shape as those obtained by the K-8-3 and K-8-4 rockets. The coincidence counts showed random distributions for altitudes greater than 50 km. An examination of several experimental data indicates that unless a high gamma-ray efficiency counter, or a high gamma-ray production is involved, all experimental data cluster. The only exception is a point obtained by Explorer 7 that may be attributed to high energy particles which are trapped, producing high energy gamma rays, rather than to a secondary effect of cosmic rays.
R.W.H.

N65-18860# Minnesota Univ., Minneapolis. School of Physics and Astronomy
THE HELIUM NUCLEI OF THE PRIMARY COSMIC RADIATION AS STUDIED OVER A SOLAR CYCLE OF ACTIVITY
P. S. Freier and C. J. Waddington Dec. 1964 109 p refs Submitted for Publication
(Contract Nonr-710(60))
(TR-CR-75; AD-455076)

Existing data on the helium nuclei of the primary cosmic radiation were incorporated in a mathematical representation of a heliocentric electric field, in order to simulate the effects of an electric field over a wide variation of the physical parameters involved. By assuming that the spectra at the sunspot source are power laws in total energy, it was shown that the modulating potential at the 1954 sunspot minima need be only about 50 MeV increasing to about 700 MeV during sunspot maxima. This electric field modulation explains, at least partially, the latitude effect of neutron monitors during sunspots; the magnitude of the modulation of neutron monitors; the differential spectral shape for helium nuclei and its variation during the sunspot cycle; the differential spectral shape for protons and the differential modulation of low rigidity protons and helium nuclei; and the modulation of the integral intensities of protons and helium nuclei. The model failed to explain the prediction of too few low-energy helium nuclei and too many low-energy protons.
G.G.

N65-18914*# California Univ., La Jolla. Dept. of Physics
AN AVERAGE ATMOSPHERE FOR PARTICLES TRAPPED IN THE EARTH'S MAGNETIC FIELD
A. Hassitt 20 Oct. 1964 23 p refs
(Grant NsG-538)
(NASA-CR-57165) CFSTI: HC $1.00/MF $0.50

Particles trapped in the earth's magnetic field follow orbits which vary over all longitudes and over wide ranges of latitude and altitude. An efficient method of averaging any spatially dependent function over these orbits is described. A Fortran program which computes average atmospheres, using an Anderson and Francis (1964) atmosphere and the Jensen and Cain (1962) 48-term representation of the earth's magnetic field, is described. This program has been run on the CDC 3600 and IBM 7090 computers.
Author

N65-19444 Minnesota Univ., Minneapolis. School of Physics and Astronomy
INTENSITY OF 80 TO 200 MEV PROTONS OVER FORT CHURCHILL ON 26 AUGUST 1960
P. S. Freier and C. J. Waddington Nov. 1964 20 p refs
(Contract Nonr-710(60))
(CR-73; AD-609961)

The intensity and energy spectrum of primary cosmic ray protons having energies between 80 and 200 MeV were studied in nuclear emulsions flown on 26 August 1960 over Fort Churchill. The upper limit to the intensity between 80 and 150 MeV of 53 ± 6 protons/M^2-sec-ster obtained in this experiment is compared with the value of 121 ± 6 protons/M^2-sec-ster quoted by Vogt (1962) from observations made just prior to and just after this experiment. The reasons for this difference are discussed, and it is concluded that it is unnecessary to make any assumptions for a relaxed modulation mechanism or for continuous solar emission of low energy protons.
Author

N65-19685*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science
OBSERVATIONAL WORK ON COSMIC GAMMA RAYS
George W. Clark 1965 22 p refs
(Grants NsG-386; AF-AFOSR-546-64; Contract AT(30-1) 2098)
(NASA-CR-57323)

Four studies are summarized on cosmic photons in the energy range from 10^4eV to over 10^{15}eV. The first study involved cosmic X-ray observation by a scintillation detector in a balloon, which produced strong evidence against the simple neutron star hypothesis for the X-ray source in the Crab Nebula. In the second citation several experiments were analyzed with the conclusion that the SCO-XI X-rays are not produced by an electron cloud. In the third case, a gamma-ray average integral intensity was determined from data in the energy range about 100 MeV from the Explorer XI astronomy satellite. Finally, from data on a search for gamma-ray showers with a ground-based installation of penetrating-particle detectors the existence of low-mu showers is inferred at various energy levels. J.M.D.

N65-19706*# Consultants and Designers, Inc., Arlington, Va.
DECIMETER BAND RADIOMETER AND MEASUREMENT OF JUPITER'S PROPER EMISSION [RADIOMETR DETSIMETROVOGO DIAPAZONA I IZMEREniYE SOBSTVENNOGO IZLUCHENIYA YUPITERA]
O. N. Rzhiga, G. I. Slobodenyuk, V. N. Titov, and Z. G. Trunova 25 Mar. 1965 8 p refs Transl. into ENGLISH from Radiotekhn. i Elektron., (Moscow), v. 10, no. 2, 1965 p 364–367
(Contract NAS5-3760)
(NASA-TT-F-9658; ST-OA-REL-10308) CFSTI: HC $1.00/MF $0.50

This paper deals with the observations of Jupiter's proper emission intensity in the frequency of about 700 Mc/sec in October 1963. The modulation radiometer, used to that effect, is described. The results of these observations corroborate the law of Jupiter's proper emission intensity variation with wavelength, corresponding to measurements by other observers in shorter and longer wavelengths. Author

N65-19713# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
POSSIBLE SOURCE MECHANISM FOR LOW-ENERGY GALACTIC ELECTRONS
Karl A. Brunstein Sep. 1964 15 p refs
(NASA-TM-X-55132; X-611-64-258) CFSTI: HC $1.00/MF $0.50

A calculation is made of the expected secondary electron flux resulting from the knock-on collisions of the primary nuclear beam with the interstellar gas. The model includes ionization losses and a statistical Fermi mechanism energy gain. Comparison is made with recent satellite experimental data. Author

N65-19714*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AN EXPERIMENTAL EXAMINATION OF LOW-ENERGY COSMIC RAY HEAVY NUCLEI
C. E. Fichtel, D. E. Guss, and K. A. Neelakantan Nov. 1964 40 p refs
(NASA-TM-X-55152; X-611-64-345) CFSTI: HC $2.00/MF $0.50

In a sounding rocket experiment a finite flux of cosmic-ray nuclei with charges greater than that of helium was detected at energies below the experimental energy cutoff of balloon-borne experiments. The particles were examined by extending large sheets of nuclear emulsions from the sides of the rocket during its period outside the atmosphere. The flux of medium nuclei ($6 \leq Z \leq 9$; Z = nuclear charge) in the energy range from 30 to 150 MeV/nucleon was measured as 0.67 ±0.13 particles/(m^2sr sec), and the flux of ($10 \leq Z \leq 19$) nuclei in the energy range from 40 to 190 MeV/nucleon was 0.31 ±0.09 particles/(m^2sr sec). A finite flux of light nuclei ($3 \leq Z \leq 5$) also was seen in the 30 to 110 MeV/nucleon region. Author

N65-19716*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INVERSE COMPTON SCATTERING OF COSMIC RAY ELECTRONS
Frank C. Jones Oct. 1964 33 p refs
(NASA-TM-X-55138; X-641-64-288) CFSTI: HC $2.00/MF $0.50

An important mode of energy loss for cosmic-ray electrons is inverse Compton scattering with photons of starlight. Previous calculations due to this process have involved nonsystematic approximations involving the form of the Klein–Nishind formula and the angular distribution of the radiation as seen in the electron's rest frame. The present paper considers an electron of arbitrary energy in an isotropic thermal radiation field of temperature T. A formally correct expression from $\langle d\epsilon/dt \rangle_{Av}$ is obtained as an asymptotic expansion in the quantity $\epsilon kT/(m_e c^2)^2$ considered as a small parameter. The result $\langle d\epsilon/dt \rangle_{Av} \propto \epsilon^2$ is seen to be the zeroth-order term in this expansion. It is also seen that the energy loss rate changes sign at an energy $\epsilon \approx 3/2$ kT as would be expected from thermodynamics. A derivation of the zeroth-order term is given from classical radiation theory; from this it is seen that this term also describes the energy loss rate due to synchrotron radiation as well as from inverse Compton scattering. Author

N65-19718*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE MAGNETOHYDRODYNAMIC WAKE OF THE MOON
Norman F. Ness Oct. 1964 61 p refs Submitted for Publication
(NASA-TM-X-55144; X-612-64-323) CFSTI: HC $3.00/MF $0.75

The possible detection of the lee wake of the magnetohydrodynamic interaction of the solar wind with the moon, as observed by the IMP-1 satellite, is discussed. The interplanetary magnetic field was found to fluctuate very rapidly and reach anomalously large values when the satellite was approximately eclipsed by the moon in December 1963. Later data on the interplanetary field in February 1964 suggest that a detached lunar shock wave analogous to that observed by IMP-1 associated with the earth may not be a permanent feature of the lunar environment. The approximate length of the wake region behind the moon is 150 lunar radii at which distance the diameter of the region is about 70 lunar radii. A review of related studies on 29.5 day periodicities of K_p is presented. The solar wind interaction with the geomagnetic field extends the magnetosphere far behind the earth. Hence, lunar synodic periodicities in K_p may reflect the interaction of the moon with the earth's magnetic tail rather than the moon's wake with the earth. Author

N65-19719*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVIDENCE FOR RAPID MOTION OF THE OUTER BOUNDARY OF THE MAGNETOSPHERE
Andrei Konradi and Richard L. Kaufmann (New Hampshire Univ.) Oct. 1964 24 p refs
(NASA-TM-X-55141; X-611-64-297) CFSTI: HC $1.00/MF $0.50

A sudden increase of the particle intensity and of the magnetic field strength on September 25, 1961 was detected by the ion–electron detector and the magnetometer on board Explorer XII outside the earth's magnetosphere. From the physical extent of the region and the energy of the trapped protons the temporal nature of the event was established. Similarities between particle fluxes as well as between magnetic fields during the increase and within the outer belt make it

probable that the increase represents an impulse-like extension of at least a portion of the outer belt. A deduced lower limit on the outward radial velocity of the extension is 156 km/sec. Crude calculations show that either the proton density near the outer edge is less than 100 cm^{-3} or the temperature is greater than 15 eV. Author

N65-19722*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
DETECTION OF INTERPLANETARY 3- TO 12-MEV ELECTRONS
T. L. Cline, G. H. Ludwig, and F. B. Mc Donald Nov. 1964 12 p refs
(NASA-TM-X-55159; X-611-64-362) CFSTI: HC $1.00/MF $0.50

The direct observation of interplanetary electrons of energy above 3 MeV with the IMP-1 satellite of Explorer 18 is reported. Also, it is demonstrated that the flux of 3 MeV electrons is a primary component of the interplanetary radiation, and the properties of these particles are discussed in terms of their possible origin, either galactic or solar. E.E.B.

N65-19761*# Catholic Univ. of America, Washington, D. C. Dept. of Space Science and Applied Physics
THE FERMI ACCELERATION OF CHARGED PARTICLES IN THE TRANSITION REGION BEYOND THE MAGNETOSPHERE
C. S. Shen and C. C. Chang 24 Dec. 1964 12 p refs
(Grant NsG-417)
(NASA-CR-57216) CFSTI: HC $1.00/MF $0.50

High energy 30-KeV electrons trapped in the transition region beyond the magnetosphere are considered. The time required to boost an electron's energy to 30 KeV is estimated. Further, it is shown that a 10-eV electron has to be trapped 7 times to reach 30 KeV and the time required is approximately 10 minutes. Basic assumption and major consequences of the theoretical considerations are included. Comparison with experimental measurements indicated good qualitative agreement with most of the consequences. E.E.B.

N65-19773*# National Aeronautics and Space Administration, Washington, D. C.
ROCKET EXPERIMENTS IN COSMIC MAGNETISM AND THEIR SIGNIFICANCE
C. P. Sonett [1964] 108 p refs Submitted for Publication
(NASA-TM-X-58142) CFSTI: HC $4.00/MF $0.75

Principle results of direct observations, made since the first lunar orbit attempt, of magnetic fields and plasmas in space are discussed. Observations bearing on the structure of the outer gaseous mantle of the earth have been made, though the number of unsolved problems appears to have increased since the first experiment on Pioneer I. Measurements of the interplanetary field and their relation to theoretical models are considered. Also, the interaction of the earth with both the undisturbed and the storm-time interplanetary mediums is included. E.E.B.

N65-19899*# National Bureau of Standards, Washington, D. C.
SOME DEVELOPMENTS IN IMPROVED METHODS FOR THE MEASUREMENT OF THE SPECTRAL IRRADIANCES OF SOLAR SIMULATORS
Ralph Stair, William E. Schneider, William R. Waters, John J. Jackson, and Roger E. Brown Washington, NASA, Apr. 1965 53 p refs
(NASA Order R-116)
(NASA-CR-201) CFSTI: HC $3.00/MF $0.50

The application of existing radiometric techniques to measure the spectral irradiance from solar simulators was critically evaluated. Special consideration was given to thermopile, photomultiplier, phototube, and PbS cell detector characteristics in the choice of instrument design, and for their value in radiometric measurements. An effort was made to minimize dark current or instrument drift effects. The conventional spectroradiometric method is recommended for primary use, and the photoelectric filter spectroradiometry is recommended for infrared observations. The use of the two systems in dual instrumentation achieved a precision of about 1% in laboratory measurements on relatively stable radiation sources. G.G.

N65-19960*# Naval Research Lab., Washington, D. C. Center for Space Research
OBSERVATIONS OF THE WHITE LIGHT CORONA FROM A ROCKET
H. W. Cooper, C. R. Detwiler, M. J. Koomen, D. M. Packer, J. D. Purcell et al Feb. 1964 57 p refs
(NASA Order R-70)
(NASA-CR-53537) CFSTI: HC $3.00/MF $0.50

The white light corona is the faint, and frequently irregular halo, extending from one to several solar radii from the limb, seen at the time of a total solar eclipse. The corona, a coronagraph for monitoring the white light corona at frequent intervals from a space observatory, the occulter, coronagraph calibration, past observations and photographs of the corona, and coronal brightness derived from photographs are discussed. The rocket experiments of June 28, 1963 resulted in the first records of the brightness of the solar corona made without the aid of a total solar eclipse. It is clear that the moon is the perfect occulter and can never be matched. It is probable that with a multiplier disc occulter an orbiting coronagraph will be able to monitor the corona with at least as great resolution and sensitivity as can be realized from the ground during a total eclipse. E.E.B.

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N65-18656# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VARIATIONAL PROBLEM OF ESCAPE FROM CIRCULAR ORBIT
V. N. Lebedev 5 Dec. 1964 10 p refs Transl. into ENGLISH from Zh. Vychislitel'noi Mat. i Mat. Fiz. (Moscow), v. 3, no. 6, 1963 p 1126–1130
(FTD-TT-64-1200/1+2+4; AD-610208)

A solution of the variational problem of escape of a space vehicle from circular orbit is presented. It is demonstrated that the escape time from a circular orbit using tangential thrust differs by less than 1% from the time obtained from a precise solution of the variational problem. Over the interval $10^{-4} \leq a \leq 5 \times 10^{-3}$ the difference is less than one half of one percent. E.E.B.

N65-18806* National Aeronautics and Space Administration, Washington, D. C.
COSPAR AND JAPANESE SPACE ROCKET RESEARCH

T. Tanaka *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p69–72 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The organization of the Committee for Space Research (COSPAR) and some past activities are described briefly. The relationship between COSPAR and Japanese space rocket research is outlined. J.M.D.

N65-18830* National Aeronautics and Space Administration, Washington, D. C.
ROCKET TRAJECTORY PLOTTED BY RADAR
Noboru Tagaki, Narihumi Saito, Motomi Nagatani, Toshimichi Kameo, Mitsum Ichigawa et al *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 216–224 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa rocket trajectories plotted by radar and automatic tracking systems are presented; these rockets were launched in the Japanese space program between July 1961 and December 1962. In addition to the plots, basic physical data are given on the rockets in flight. J.M.D.

N65-18868# RAND Corp., Santa Monica, Calif.
MINIMUM ENERGY LOSS HEADING CHANGES FOR HYPERSONIC FLIGHT FROM ORBIT
Russell D. Shaver Jan. 1965 135 p refs
(Contract AF 49(638)-700; Proj. RAND)
(RM-4391-PR; AD-610527)

Velocity requirements for minimum energy loss during orbit turning were derived for the aerodynamic synergetic mode of transfer and for the pure rocket bielliptic transfer. Velocity requirements obtained through an optimal energy transfer study are compared to those for a rocket transfer, indicating that there are large areas of near-earth transfer regimes where a synergetic transfer requires substantially less fuel than the corresponding rocket transfer. Vehicle design problems are discussed in an examination of minimum energy loss inclination changing maneuvers. Indicated total heat, maximum heat rates, and normal wing loading are included for each trajectory considered. From these curves, certain design criteria are obtained and their influence on performance is examined, particularly in relation to their influence upon velocity requirements for the orbit transfer. From the results of the optimization program, a simple control scheme is devised which produces near-optimal performance and can be modified to overcome structural difficulties. Synergetic transfers can be investigated by simple numerical schemes. Author

N65-18923# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
EFFECTS OF THERMAL EXPANSION ON THE MOMENTS OF INERTIA OF THE MOON
Zdeněk Kopal Jan. 1965 31 p refs
(DI-82-0400)

Thermal conduction problem for a homogeneous sphere illuminated by a parallel beam of light is solved in terms of Fourier–Bessel expansions; the resulting nonsymmetric deformation due to thermal expansion is established on the assumption that the (self-gravitating) sphere behaves like an elastic solid. The moments of inertia about the principal axes of so deformed a body are then computed for a configuration approximating in physical properties the lunar globe as deformed by secular effects of insolation; it is shown that the ratio of the differences of the momenta (C-A)/B which can arise from this cause is much too small to account for its value deduced from the librations. Author

N65-18924# Boeing Scientific Research Labs., Seattle, Wash. Geo-Astrophysics Lab.
THERMAL ANOMALIES ON THE TOTALLY ECLIPSED MOON OF DECEMBER 19, 1964
J. M. Saari and R. W. Shorthill Jan. 1965 11 p refs Submitted for Publication
(DI-82-0404)

The lunar disk was scanned in the infrared nine times during the total eclipse of December 19, 1964. As expected from previous work, the major ray craters cooled less rapidly than their environs. However, hundreds of localized hot spots were discovered on the disk, some of which have been identified with small ray craters. Mare Humorum and certain portions of other seas were found to be thermally enhanced compared to their surroundings. Author

N65-18937*# Arizona Univ., Tucson. Lunar and Planetary Lab.
COMMUNICATIONS OF THE LUNAR PLANETARY LABORATORY, VOLUME 3, NO. 40: THE SYSTEM OF LUNAR CRATERS, QUADRANT II
D. W. G. Arthur, Alice P. Agnieray, Ruth A. Horvath, C. A. Wood, and C. R. Chapman
(Grant NsG-161)
(NASA-CR-57208) CFSTI: HC $3.00/MF $0.75

The designation, diameter, position, central-peak information, and state of completeness are listed for each discernible crater in the second lunar quadrant with a diameter exceeding 3.5 km. The catalog contains more than 2000 items and is illustrated by a map in 11 sections. Author

N65-18944*# Stanford Univ., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Report, No. 4, 1 Jul.–31 Dec. 1964
V. R. Eshleman Jan. 1965 11 p refs
(Grant NsG-377)
(NASA-CR-57184) CFSTI: HC $1.00/MF $0.50

Research covered includes theoretical and experimental radio and radar studies of lunar and planetary ionospheres, atmospheres, and surfaces, and radar studies of the sun and interplanetary medium. Specific projects cover a radar-occultation method for the study of planetary atmospheres, possible models for the atmosphere of Mars, magnetohydrodynamic waves in interplanetary space, a solar radar program, studies of cislunar gas, and data processing. D.E.W.

N65-18946*# Stanford Univ., Calif. Radioscience Lab.
THE BISTATIC RADAR-OCCULTATION METHOD FOR THE STUDY OF PLANETARY ATMOSPHERES Scientific Report No. 5
G. Fjeldbo and V. R. Eshleman Feb. 1965 34 p refs
(Grant NsG-377)
(NASA-CR-57178; SEL-65-010) CFSTI: HC $2.00/MF $0.50

Theoretical studies were made of the characteristics of radio waves diffracted at the limb and refracted in the atmosphere of a planet. Sample computations were made of atmospheric perturbations to the communication links to and from a Mars flyby spacecraft having a trajectory that involves occultation of the spacecraft by the planet as seen from the earth. It is concluded that such a radio occultation experiment can provide important new information on the atmospheric scale height and surface density of a planetary atmosphere, and when combined with other information, can help determine atmospheric constituents. Author

N65-18975*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ON THE GENERAL PERTURBATIONS OF THE POSITION VECTORS OF A PLANETARY SYSTEM
Peter Musen Washington, NASA, Mar. 1965 25 p refs
(NASA-TN-D-2692) CFSTI: HC $1.00/MF $0.50

A theory of the general perturbations of a planetary system is developed. The perturbations of the position vector of each planet are expanded into series arranged in powers and products of the masses m_1, m_2..., m_n of the planets constituting the system. Perturbations of different orders are obtained in the form of series containing the purely periodic, the secular, and the mixed terms. The influence of the lower order perturbations on the other ones is determined. The explicit calculation is carried out for the perturbations of the first, second, and third orders; and the procedure for determining the higher order perturbations is outlined. Decomposing each perturbation of any particular planet m_i along the undisturbed position vector $\overrightarrow{r_i}$, along the undisturbed velocity $\overrightarrow{v_i}$, and along the unit vector $\overrightarrow{R_i}$ normal to the undisturbed orbital plane, the differential equations are reduced to a form easily integrable by quadratures. The results extend and generalize the previous results to the case of the whole planetary system. The method suffers from disadvantages common to all astronomical methods of the general planetary perturbations. It is not applicable to a pair if their orbits approach each other very closely. Author

N65-19010# Boeing Scientific Research Labs., Seattle, Wash. Mathematics Research Lab.
POSSIBLE EFFECTS OF CONVECTION ON LUNAR MOMENTS OF INERTIA Mathematical Note No. 385
Zdeněk Kopal Jan. 1965 17 p refs
(DI-82-0401)

The differences in moments of inertia of a homogeneous globe of viscous liquid arising from steady convection in its interior are evaluated on the basis of a linearized theory of such motion as developed by Chandrasekhar in 1952. It is shown that if the physical characteristics of such a globe are made to approximate the anticipated properties of the moon, with the same difference C − A of momenta about its principal axes of inertia, Chandrasekhar's theory requires (1) the velocity of convective motion to be of the order of 10^{-8} cm/sec (too small for the establishment of steady flow for a globe of lunar dimensions in 10^9 years), and (2) a characteristic Rayleigh number several hundred times as large as that required theoretically for the stability of the respective flow. It is concluded that internal convection conforming to the theory does not lend itself to the actual explanation of the difference in momenta. Author

N65-19026# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOTION OF CLOSE ARTIFICIAL SATELLITES
Y. Kozai 12 Jan. 1965 19 p refs Transl. into ENGLISH from Dokl., Konf. po Obshch. i Prikl. Vopr. Teor. Astron., 1961 (Moscow), 1963 p 107–118
(FTD-MT-64-349; AD-611042)

The influence of perturbations from flattening, and of lunar–solar perturbations on the motion of close artificial satellites was studied in detail. Effects caused by solar radiation pressure, and the difficulty of obtaining analytic expressions for these effects are discussed. Mathematical expressions are given for the lunar–solar effects after 1 turn of the satellite, after 10 turns, and from long-period perturbations. Also, indirect effects of lunar–solar attraction, caused by precession and nutation, were studied. E.E.B.

N65-19027# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL APPLICATION OF TELEVISION EQUIPMENT FOR OBSERVATION OF STARS
Ye. S. Agapov, V. F. Anisimov et al 6 Nov. 1964 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (Moscow), v. 30, 1963 p 3–18
(FTD-MT-64-411; AD-611043)

A television device used for observations of astronomical objects is described in brief. The results of preliminary tests of the device at the Crimean Astrophysical Observatory are given. It is shown that in the photography of stars with a diameter of the image of the order of 0.1 mm, there is a gain in exposure by a factor of 70 as compared to HP-3 Ilford plates. Photometric estimates of photographs obtained from the screen of the video-control apparatus can be made with a precision of not less than ±0.15 magnitude. Experimental photographs of spectra of faint stars were taken also. Author

N65-19202# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RENDEZVOUS IN THE ORBIT
L. Gil'berg 9 Nov. 1964 18 p Transl. into ENGLISH from Znanie Sila (Moscow), no. 4, 1964 p 38–41
(FTD-TT-64-1169/1+2; AD-609139)

Problems in rendezvous of spacecraft in flight are discussed. The United States Apollo project is described in detail. The Russian concept of a series of intermediate space stations for landing and takeoff during extended flights is also described briefly. Tentative plans for refueling of spacecraft, as well as obstacles yet to be overcome, are discussed. J.M.D.

N65-19257# Naval Research Lab., Washington, D. C. Applications Research Div.
THE COMPUTATION OF OPTIMUM ORBITAL ELEMENTS DERIVED FROM A SINGLE COINCIDENT OBSERVATION BY TWO RECEIVING STATIONS OF THE NAVAL SPACE SURVEILLANCE SYSTEM
Howard Gerard de Vezin, Jr. (M.S. Thesis, Maryland Univ.) 22 Oct. 1964 74 p refs
(NRL-6172; AD-608697)

A method of computing orbital elements using all of the information that the system does measure or can be adapted to measure is described. This method would introduce weighting factors determined, e.g., by the accuracy with which the system can measure the parameter in question. This method is then used to study the effect that the addition of doppler shift and bistatic range measurements have on the accuracy of the resulting orbital elements. Author

N65-19281*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
INFLUENCE OF SOLAR RADIATION PRESSURE ON ORBITAL ECCENTRICITY OF A GRAVITY-GRADIENT-ORIENTED LENTICULAR SATELLITE
William M. Adams, Jr. and Ward F. Hodge Washington, NASA, Mar. 1965 24 p refs
(NASA-TN-D-2715) CFSTI: HC $1.00/MF $0.50

A method is presented for calculating the perturbations of the orbital elements of a low-density lenticular satellite due to solar radiation pressure. The necessary calculations are performed by means of the digital computer. Typical results are presented for seven orbital inclinations ranging from 0° to 113° for a perfectly absorptive satellite initially in a nearly circular 2000-nautical-mile orbit. The information obtained

indicates that the change in eccentricity caused by solar radiation pressure becomes large enough for all the inclinations considered to cause attitude-control problems with the gravity-gradient stabilization system. A nearly circular orbit appears necessary for lenticular satellites, since the ability of gravity-gradient attitude-control systems to damp the pitching libration induced by elliptic orbital motion is still in doubt. The results also indicate that the effects of solar radiation pressure on the orbital eccentricities of lenticular and spherical satellites are nearly the same when the two configurations are compared on an equal area-to-mass ratio basis. Author

N65-19306# Naval Research Lab., Washington, D. C.
FIRST ORDER OBLATENESS PERTURBATIONS AND THE U.S. NAVAL SPACE SURVEILLANCE SYSTEM
Thomas Blackhall Murtagh (M.S. Thesis, Maryland Univ.) 5 Nov. 1964 75 p refs
(NRL-6169; AD-609566)

The space surveillance system is described, and an error analysis is presented involving a comparison of position errors in the orbital path of an artificial earth satellite that were produced either by the inclusion or omission of first-order oblateness effects on all of the orbital elements or by the introduction of theoretical errors into the system with which the measurements are made. The reasons for making this comparison are: (1) If the improved model of the earth's gravitational field produces an increased accuracy in the orbital elements commensurate with the accuracy of the measuring system, then this more accurate model should be used in the derivation of any epoch set of orbital elements from raw data as well as in any scheme for predicting satellite position as a function of time from epoch. (2) If the improved model accuracy is not comparable to the measuring system accuracy, then the inclusion of these first-order effects is not necessary and their omission will reduce expenditures for the use of the high-speed digital computer necessary for obital element computation and updating. Author

N65-19313# Lincoln Lab., Mass. Inst. of Tech., Lexington.
DRAFT PROGRAM DESCRIPTION FOR RADAR AND RADIOMETRIC LUNAR SURFACE STUDIES
P. B. Sebring, ed. 20 Nov. 1964 53 p refs *Its* Group Report 1964-65
(AD-609384)

A radar and radiometry study of the surface of the moon has revealed basic data on the lunar surface. Radar mapping showed that major craters are strong scatterers, which implies the presence of solid rock. Data on backscatter gain allow calculation of the reflection coefficient, from which an approximate dielectric constant of 2.8 was derived. This constant, along with thermal data obtained by radiometry, suggests a surface bulk density of about 50%. The nature of future microwave radar, optical radar, and radiometry studies of the moon was determined from these earlier results; the proposed studies are described. J.M.D.

N65-19455# Sylvania Electric Products, Inc., Mountain View, Calif. Electronic Defense Labs.
A TWO-BODY PROGRAM FOR THE SIMULATION OF BALLISTIC-MISSILE AND EARTH-SATELLITE MOTION
Richard D. Bauman 31 Aug. 1964 99 p refs
(Contract DA-36-039-AMC-03404(E))
(EDL-M717; AD-458400)

The two-body assumption provides the basis for a useful approximation to the motion of earth satellites and ballistic missiles. A computer program was developed to implement the two-body equations. The theory and operation of the program are described in detail. The program can accept data in various forms. The solution of the two-body equations is then accomplished by an extremely concise vector technique. The output of the program can be varied so as to include such information as ground tracking, vehicle orientation angles, observer tracking data, tracking rates, and atmospheric refraction corrections. A listing of the program and complete operating instructions are included. Author

N65-19505*# National Aeronautics and Space Administration, Washington, D. C.
OUTLINES OF THE UNIVERSE
B. A. Vorontsov-Vel'Yamonov Mar. 1965 489 p Transl. into ENGLISH of "Ocherki o vselennoy" Moscow, Nauka Publishing House, 1964
(NASA-TT-F-9034) CFSTI: HC $7.89/MF $2.50

Current status of astronomy is presented in a popular style of writing. Chapters of the book are entitled: *The Main Members of the Solar System, The Little Planets, Visible Nothing, Shooting Stars and Meteoric Storms, Heavenly Rocks and Dust, The Sun—The Closest of Stars, Stars Are Distant Suns, Islands of the Universe, The Life of Stars, Stars Which Destroy Themselves, The World of Dispersed Gases, Radio Conference with Outer Space,* and *Development of the Worlds.* E.E.B.

N65-19510*# National Aeronautics and Space Administration, Washington, D. C.
APPLICATION OF THE METHODS OF ANALYTICAL DYNAMICS TO THE THEORY OF OPTIMAL FLIGHTS [PRIMENENIYE METODOV ANALITICHESKOY DINAMIKI V TEORII OPTIMAL'NYKH POLETOV]
Y. S. Novoselov Mar. 1965 22 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 3, 1964 p 133-146
(NASA-TT-F-9294) CFSTI: HC $1.00/MF $0.50

By integrating the variational formula of the action functional over the trajectories or arcs of a special field of extremals, the maximum principle is proved, and the sufficient conditions of the extremum are established. The possible application of the Hamilton-Jacobi method to the construction of optimal regimes is pointed out; starting from that method, equations defining the optimal impulse transfers between coplanar orbits are obtained. Author

N65-19624# University of Southern Calif. Engineering Center, Los Angeles.
MODELING CRITERIA AND TESTING TECHNIQUES FOR THE SIMULATION OF SPACE ENVIRONMENTS
John B. Wainwright, Lawrence R. Kelly, Donald A. Wallace, and Thomas H. Keesee Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 183 p refs
(Contract AF 33(657)-8737)
(AFFDL-TR-64-164; AD-609858)

The report covers an investigation of the possibility of using scale modeling to simulate environmental stresses on a space vehicle. General scaling laws were derived for simulating solar and planetary radiation, reaction jets impinging on a vehicle surface and mechanical vibration. Distortions in the simulated environment such as those produced by imperfect radiation sources, residual test chamber gas, and the near presence of chamber walls were evaluated relative to induced measurement errors. Thermal simulation and mechanical vibration experiments are described which were designed to demonstrate the utility of the derived techniques. Author

N65-19648# Tokyo Astronomical Observatory (Japan).
ANNALS OF THE TOKYO ASTRONOMICAL OBSERVATORY, SECOND SERIES, VOLUME VIII, NUMBER 3
Naosuke Sekiguchi, Fumiko Nemichi, Haruo Yasuda, and Hisao Hara 1964 36 p refs

1. ON A NEW METHOD OF EXTRAPOLATION OF THE POLAR MOTION N. Sekiguchi and F. Nemichi 18 p refs

2. THE CATALOGUE OF 240 STARS IN THE PZT PROGRAMS OF MIZUSAWA, RICHMOND, TOKYO, AND WASHINGTON H. Yasuda and H. Hara 9 p

N65-19686*# California Univ., San Diego.
ROTATION AND MASS OF THE Sa GALAXY, NGC 681
E. Margaret Burbridge, G. R. Burbridge, and K. H. Prendergast (Columbia Univ.) Feb. 1965 13 p refs
(Grant NsG-357)
(NASA-CR-57289) CFSTI: HC $1.00/MF $0.50

The Sa galaxy NGC 681 has been found to have emitting gas throughout its disk component so that a rotation curve, mass distribution, and mass within a radius of 5250 pc have been derived. These prove to be very similar to those found for Sc galaxies, despite the Sa classification and the structural similarity of this galaxy to the well-known NGC 4594. The mass of NGC 681 is $1.9 \times 10^{10} M_{\odot}$, the mean density 1.0×10^{-23} gm/cm^3, and the mass-to-light ratio 3.6. Author

N65-19699*# Philco Corp., Palo Alto, Calif. WDL Div.
COMET AND CLOSE-APPROACH ASTEROID MISSION STUDY. VOLUME I: SUMMARY REPORT Final Report
A. Giddis, R. Jensen, M. Fluck, H. Bustamante, J. Fairbanks et al 2 Jan. 1965 132 p Prepared for JPL
(Contracts NAS7-100; JPL-950870)
(NASA-CR-57301; WDL-TR2366) CFSTI: HC $4.00/MF $1.00

Trajectory and guidance, system requirements, guidance and control, telecommunications, power, thermal control, spacecraft configurations, Mariner-C Comet probes, spacecraft system evaluation, and mission cost and schedule are covered in this volume of the eight-volume report. E.E.B.

N65-19731*# Consultants and Designers, Inc., Arlington, Va.
LUMINOSITY FUNCTIONS OF NORMAL GALAXIES IN PHOTORANGES AND RADIOBANDS [FUNKTSII SVETIMOSTI NORMAL'NYKH GALAKTIK V FOTO i RADIODIAPAZONAKH]
Yu. P. Pskovskiy 16 Mar. 1965 10 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. III, Fiz.-Astron. (Moscow), no. 1, 1965 p 3–8
(Contract NAS5-3760)
(ST-IGA-10305; NASA-TT-F-9654) CFSTI: HC $1.00/MF $0.50

The radioindices of nearest normal galaxies are considered. A dependence between the optical luminosity and radioindices of later-type galaxies is revealed. The luminosity functions of later and earlier-type galaxies were determined in the photographic range. The radioluminosity of normal galaxies was determined with the help of the photographic luminosity function and of radioindices of later-type galaxies. Author

N65-19736# Tokyo Astronomical Observatory (Japan).
MOLECULAR ABUNDANCE IN STELLAR ATMOSPHERES
Takashi Tsuji 1964 112 p refs *Its* Ann. of the Tokyo Astron. Obs., 2d Ser., Vol. 9, No. 1

The dissociation constants of 102 molecules are calculated on the basis of the recent molecular constants. It is shown, both theoretically and observationally, that the assumption of the thermodynamical equilibrium for molecular dissociation in stellar atmospheres is a fully satisfactory approximation in discussing the molecular abundance in stellar abundance in stellar atmospheres. The comparisons of the results so obtained show better agreement than do the previous works with the observed molecular features in stellar spectra: The C_2 concentration in carbon rich stars goes through maximum at about 2500° K in agreement with the observed maximum; the so-called ultraviolet depression in carbon stars which was identified as due to C_3 molecules is also reasonably understood on the basis of these results; the behavior of CN and CH bands both in oxygen rich as well as in carbon rich stars shows sufficient agreement with the predicted molecular features. Also discussed are the possibilities of observing the spectra of polyatomic molecules in stellar spectra, the significance of polyatomic molecules as a source of opacity, a possibility of determining H:C:N:O ratio in cool stars, and a possible role of cool stars as a source of supply of interstellar molecules. Author

N65-19747# National Aeronautics and Space Council, Washington, D. C.
THE CHALLENGE OF INTERNATIONAL COMPETITION
Charles S. Sheldon, II [1965] 60 p Presented at the AIAA/NASA 3d Manned Space Flight Meeting, Houston, Tex., Nov. 1964

The space flight programs of the United States and the Soviet Union are summarized and compared. The actual accomplishments of the Soviet Union in this field are discussed in detail. Some of the ascertainable policy guidelines used by these two countries, and by a secondary group of emerging space-interested countries, to shape their plans for the future are explored. Conjectures about the future of space flight and the potential uses of extraterrestrial space are also stated and discussed. D.E.W.

N65-19768*# Ohio State Univ., Columbus. Antenna Lab.
[STUDIES OF THE RELATIONS BETWEEN THE RADAR SCATTERING PROPERTIES OF "MOON-LIKE" SURFACES AND THEIR SURFACE FEATURES] Semiannual Summary Report, 1 May–31 Oct. 1964
Robert C. Taylor 10 Feb. 1965 4 p refs
(Grant NsG-213-61)
(NASA-CR-57313) CFSTI: HC $1.00/MF $0.50

This report summarizes the work carried out on studies of the relations between the radar-scattering properties of moonlike surfaces and their surface features. Three areas of study were pursued to provide fundamental data concerning the determination of the physical characteristics of a surface with emphasis on the lunar-type surfaces from the electromagnetical scattering characteristics. These areas of study are (1) theoretical studies of the two-frequency radar experiment and other experiments that might prove of value, (2) measurement of the complete scattering properties of moonlike surfaces on the model range, and (3) measurement of the scattering properties of the moon. Author

N65-19770*# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics
[GROUND-BASED OBSERVATIONS OF VENUS IN THE WAVELENGTH RANGE FROM 0.90 TO 1.40 cm AND BALLOON-BORNE MEASUREMENTS OF MICROWAVE EMISSION FROM MOLECULAR OXYGEN IN THE TERRESTRIAL ATMOSPHERE Final Report, Jun. 1–Dec. 31, 1964

Alan H. Barrett 4 Jan. 1964 5 p refs
(Grant NsG-250-62)
(NASA-CR-57309) CFSTI: HC $1.00/MF $0.50

Wavelength and brightness measurement values of Venus radio spectra do not agree with those computed previously, which considered nonresonant emission mechanisms involving carbon dioxide and nitrogen as the model. However, the observed values can be approximately matched by including water in the atmospheric model because of the resonant line at 1.35 cm for water. It is also possible that the observations can be fitted with a model which includes microwave scattering with either resonant or nonresonant absorption. The measurement of the $N = 9^+$ line of molecular oxygen during ascent, at float, and during descent is also reported. E.E.B.

N65-19775*# IIT Research Inst., Chicago, Ill. Technology Center
STUDIES OF LUNAR SOIL MECHANICS, Final Report, Jun. 15, 1963–Dec. 15, 1964
E. Vey and J. D. Nelson Feb. 1965 142 p refs
(Contract NASr-65(02))
(NASA-CR-57281) CFSTI: HC $4.00/MF $1.00

This program investigated properties of simulated lunar soils in lunar environment. Experiments were performed on samples of quartz and olivine powders and fine and coarse grained quartz sand having various grain size distributions. Vacuum levels ranged from atmospheric pressure to the low 10^{-11} torr range with temperatures from approximately 250° to 0° F. The vacuum in the pores of a soil sample could be two to three orders of magnitude less than the chamber vacuum. However, the dominant factor affecting the soil properties was the amount of adsorbed gas removed from the soil grains. Removal of adsorbed gas caused development of attractive interparticle forces which caused an increase primarily in the apparent cohesion at room temperature with further removal of gas under elevated temperatures causing an increase primarily in the angle of internal friction. Low temperatures also caused an increase in apparent cohesion under vacuum. In the olivine powder, the vacuum caused an increase in apparent cohesion at elevated temperatures. In sand, ultrahigh vacuum and elevated temperatures increased the angle of internal friction. Author

N65-19837*# National Aeronautics and Space Administration, Washington, D. C.
GT-3 PRESS CONFERENCE WITH ASTRONAUTS, MARCH 25, 1965 News Release
[1965] 24 p Available from the Scientific and Technical Information Division

Astronauts Grissom and Young's account of the first Gemini orbital flight is presented. Their description covers launch, first-stage flight and rocket separation, booster performance and debris around spacecraft after booster separation, problems with electrical systems, attitude control difficulties, computer guidance on spacecraft speed, change in orbit by thruster engines, functioning of space-radiator cooling system, eating at zero gravity, view from windows and photographs of land areas, control of retrofire, reentry and release of retropack, performance of drogue parachute, and landing and sea rescue. J.M.D.

N65-19858*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ADVANCED SPACEBORNE DETECTION, TRACKING, AND NAVIGATION SYSTEMS STUDY AND ANALYSIS. VOLUME I: SUMMARY
Jul. 1964 143 p refs
(Contract NAS8-11205)
(NASA-CR-57438) CFSTI: HC $4.00/MF $1.00

The principal assumptions, results, and recommendations relative to the development of spaceborne detection, tracking, guidance, and navigational systems for use in manned or unmanned vehicles are summarized. Author

N65-19859*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ADVANCED SPACEBORNE DETECTION, TRACKING, AND NAVIGATION SYSTEMS STUDY AND ANALYSIS. VOLUME II, PART I: PROBLEM DEFINITION
Jul. 1964 103 p refs *Its* Rept.-1750B
(Contract NAS8-11205)
(NASA-CR-59841) CFSTI: HC $4.00/MF $0.75

The specific problem of determining navigation and control sensor requirements for local or onboard guidance of the manned or unmanned lunar mission is developed. As a preliminary to analysis, the lunar missions are divided into phases in order of mission occurrence. These are midcourse phase, parking orbit and descent phase, lunar landing phase, lunar ascent phase, and lunar rendezvous phase. Trajectory and guidance models and an analytical plan are developed for subsequent analyses. Author

N65-19860*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ADVANCED SPACEBORNE DETECTION, TRACKING, AND NAVIGATION SYSTEMS STUDY AND ANALYSIS. VOLUME IV: PARTS I AND II — EARTH ORBITAL RENDEZVOUS
Jul. 1964 211 p refs *Its* Rept.-17500
(Contract NAS8-11205)
(NASA-CR-57439) CFSTI: HC $6.00/MF $1.25

Section one defines the basic problem with respect to the goals to be realized, the constraints imposed by physical laws and natural phenomena, and possible mathematical solutions to the problem. Section two then uses the groundwork of section one to determine somewhat ideal nominal solutions as well as parametric studies of variations about nominal values. This type of approach defines basic specifications for the system and its subsequent mechanization. Although this report is concerned with sensor requirements, overall systems, including the guidance and control sections, are defined to provide a method for evaluation. Local (onboard) navigation, guidance, and control is assumed. Error criteria to be used as a basis for evaluation are then established and the results specify sensor requirements for rendezvous. In the analyses, extensive use is made of various computer programs to simulate the rendezvous procedure. These programs are discussed in appendixes. Author

N65-19861*# Westinghouse Electric Corp., Baltimore, Md. Aerospace Div.
ADVANCED SPACEBORNE DETECTION, TRACKING, AND NAVIGATION SYSTEMS STUDY AND ANALYSIS. VOLUME V: ANALYTICAL SUPPLEMENT (APPENDIXES TO VOLUME III)
Jul. 1964 256 p refs *Its* Rept.-1750E
(Contract NAS8-11205)
(NASA-CR-57440) CFSTI: HC $6.00/MF $1.50

This final volume contains all analytical background material not an integral part of previous presentations. A summary of mathematical techniques used in the minimum variance orbital navigation and the adjoint guidance studies is

given. Midcourse phase, lunar parking and descent orbits, lunar landing analyses, lunar ascent, and lunar rendezvous are also given in supplementary analyses. Author

N65-19873*# George Washington Univ., Washington, D. C.
INTERACTION OF UNITED STATES OBJECTIVES IN SPACE WITH THOSE ON EARTH Program of Policy Studies in Science and Technology Paper No. 2
Vincent P. Rock Nov. 1964 19 p
(Grant NsG-727)
(NASA-CR-57485) CFSTI: HC $1.00/MF $0.50

The space program of the United States can make a substantial contribution to domestic economic progress. Besides invigorating the economy as a whole, space research should provide an opportunity for raising the skills and educational standards of a portion of the population. The needs of the whole society must be considered if the exploration of outer space is to be integrated into national life. The mastery of the environment of the solar system should be the primary goal in space. On earth the United States should seek leadership of a worldwide program directed to strengthening the bonds of common interest among the nations of the world. Author

N65-19882*# ADCOM, Inc., Cambridge, Mass.
COMMAND SYSTEM STUDY FOR THE OPERATION AND CONTROL OF UNMANNED SCIENTIFIC SATELLITES. TASK 1: UNIFIED TRACKING/COMMAND/TELEMETRY AT LUNAR DISTANCES First Quarterly Progress Report, 30 Jun.–30 Sep. 1964
A. M. Manders and S. M. Sussman [1964] 50 p
(Contract NAS5-9705)
(NASA-CR-57510) CFSTI: HC $2.00/MF $0.50

A comparative analysis is presented of two phase demodulators for command extraction at the spacecraft. Distortion caused by intermodulation between command and tracking signals is treated. Specific conclusions are these: (1) Phase demodulation by means of a discriminator–integrator combination is less effective than by means of a synchronous detector. The latter requires carrier extraction at the spacecraft, e.g., a phase-lock loop. (2) Reliable commanding at lunar ranges is possible over the range rate system with a command phase deviation of 0.5 to 0.72 radian and a data rate of 1200 to 2400 bits per second using a synchronous demodulator in the spacecraft. (3) For simultaneous ranging and commanding the strongest intermodulation products are about 30 dB below the major ranging tones. The choice of 10.5 kcps and 16 kcps produces no intermodulation products in the vicinity of any minor ranging tone. Author

N65-19900*# National Aeronautics and Space Administration, Washington, D. C.
LUNAR SURFACE STUDIES A Continuing Bibliography, Apr. 1964–Jan. 1965
Mar. 1965 61 p refs
(NASA-SP-7003(01)) CFSTI: HC $1.00/MF $0.75

Contained in this bibliography are references to a variety of specific topics including the theory of lunar origin, the lunar atmosphere, and the physical characteristics of the body such as its topography, geology, cartography, and stratigraphy. Techniques of lunar observation, measurement, and analysis, e.g., photography, photometry, and spectrophotometry, are amply covered, and pertinent references to the instrumentation and equipment used in lunar investigation have also been included. R.W.H.

N65-19928*# National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.
ADVANCED RESEARCH AND TECHNOLOGY IN THE AEROSPACE PROGRAM
Floyd L. Thompson 16 Mar. 1965 13 p Talk Presented to the AIAA Hampton Roads Section, Hampton, Va.
(NASA-TM-X-56202) CFSTI: HC $1.00/MF $0.50

Dr. Floyd L. Thompson, National Aeronautics and Space Administration, discussed the importance of advanced research and technology activities for the success of the nation's aerospace efforts, with emphasis on the Langley Research Center. A history of this research center as a national laboratory to study the various problems of flight, and its collaboration with other aeronautical research laboratories, is given. The responsibility of engineers and engineering to exploit natural resources and natural laws for the benefit of mankind should be reaffirmed, and a decision made as to what should be done, rather than merely how it should be done. G.G.

N65-19941# Congress. House. Committee on Government Operations.
SATELLITE INFORMATION FROM THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, GPO, 1965 22 p ref 9th Rept. by the Comm. on Govt. Operations, 89th Congr., 1st Session, House Rept. No. 197, Union Calender No. 87

Congressional committee hearings on NASA news policies are reported. The NASA officials were questioned on information policies concerning United States and Russian space activities, methods of issuing news through Government agencies, extent of NASA knowledge of Russian space achievements, and agreements between NASA and the Department of Defense on public information. It was concluded that NASA was in error in yielding to military judgment that news on Russian launchings and satellite failures should be withheld from the American public. J.M.D.

N65-19955# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A THEORETICAL METHOD FOR PRECISION RENDEZVOUS STATION-KEEPING
D. W. Eliason 15 Dec. 1964 24 p refs
(LMSC-6-62-64-23)

A method is proposed for maintaining two or more space vehicles in relatively close proximity on orbit without attachment over long periods of time. The proposed system employs a guidance and control configuration normally present in piloted rendezvous space vehicles as well as a precision optical device, and is based on the creation of an onboard analog of the target–vehicle motion. This is possible because of the linearity of the equations of motion with respect to the initial conditions. The onboard analog is related to the target–vehicle system by a scale factor. The optical device is similar in some respects to devices proposed for purely gravitational orbit guidance. This study describes the possible application of such a sensor in deriving accurate relative velocity information for station-keeping. The characteristics of the device required for system feasibility are discussed and the operational sequence of the technique is described. Author

N65-19961*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE RELATIONSHIP BETWEEN THE SYSTEM OF ASTRONOMICAL CONSTANTS AND THE RADAR DETERMINATIONS OF THE ASTRONOMICAL UNIT

Duane O. Muhleman 22 May 1963 48 p refs
(NASA-CR-51228) CFSTI: HC $2.00/MF $0.50

The determination of the astronomical constant with radar is discussed and an extensive error analysis of this technique is made. The system of astronomical constants is defined, and the relationship between the individual constants is developed. The derivation of the value for the velocity of light is discussed, since, even though the modern value is known reliably to six figures, the uncertainty in the light-velocity determinations is the major single source of error in the radar measurements. The determination of the astronomical unit by radar at the 1961 and 1962 inferior conjunction of Venus was made by several groups, and their results are all in agreement. However, Newcomb's ephemerides tables of the Sun and Venus were employed in all cases, so that the error, if any, would affect each determination in essentially the same way. The magnitudes of the possible errors are discussed, and it is concluded that the uncertainties are of such a nature that the radar observations will ultimately yield definitive corrections to the fundamental ephemerides. The preliminary best value of the astronomical unit on the basis of these recent radar observations is given as 149 598 757 ±670 km. M.P.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N65-18788*# National Aeronautics and Space Administration, Washington, D. C.
NASA SCHEDULES FIRST MANNED GEMINI FLIGHT FROM CAPE KENNEDY
17 Mar. 1965 61 p
(NASA News Release-65-81) Available from the Scientific and Technical Information Division

The National Aeronautics and Space Administration announced plans for the first manned Gemini flight designated GT-3. A successful flight will achieve the first maneuvering of an orbital plane by the crew, and use of a variable lift capability by the crew during the reentry to fly to a selected area. Inflight scientific experiments will be carried out to test the effects of weightlessness on living cells, to measure the effect of weightlessness and radiation on human white blood cells, and to direct radio signals through the plasma sheet of the spacecraft during reentry with the help of ejected water. Studies of the cardiovascular effects of space flight, and space food experiments will also be carried out. An overall description of the Gemini technical background is given, along with crew biographies and details on the various experiments. G.G.

N65-18801*# National Aeronautics and Space Administration, Washington, D. C.
SURVEY OF JAPANESE SPACE PROGRAM WITH EMPHASIS ON KAPPA AND LAMBDA TYPE OBSERVATION ROCKETS
Hideo Itogawa *et al* Feb. 1965 449 p refs Transl. into ENGLISH by Scripta Technica, Inc. from Seisan-Kenkyu (Tokyo), v. 15, no. 7, 1963
(NASA-TT-F-303) CFSTI: HC $7.00/MF $2.25

The development, performance, and aerodynamic characteristics of a series of observation rockets and associated facilities and equipment are presented. For individual titles see N65-18802–N65-18851.

N65-18802* National Aeronautics and Space Administration, Washington, D. C.
A SCHEDULE FOR OBSERVATION ROCKETS IN 1963
Hideo Itogawa *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 28–43 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Various Kappa rockets and their flights for gathering space observations are described. The rockets were fired during June 1958–May 1963. Plans are presented for work through 1967 on (1) engine testing, (2) rocket design and construction, (3) test flights, and (4) service flights. Payload, economy, acceleration, safety, and reliability factors are discussed. J.M.D.

N65-18803* National Aeronautics and Space Administration, Washington, D. C.
MEASURING DEVICES AND OBSERVATIONS
Noboru Takaki *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 44–48 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Devices for gathering space flight information are described for Kappa and Lambda rockets in the Japanese space program. These include (1) a radar system used for rocket tracking, (2) teletransmitter to convey space data to receiving stations, and (3) devices for measuring or counting cosmic rays, particles, or ions during flight. J.M.D.

N65-18807* National Aeronautics and Space Administration, Washington, D. C.
KAPPA-8L ROCKETS
Hideo Itogawa *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 73–74 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Weights and lengths are compared for the K-6, K-6H, and K-8L Kappa rockets in Japanese space rocket research. Modifications in rocket dimensions, weight, propellant, and firing conditions are discussed which might improve performance. J.M.D.

N65-18808* National Aeronautics and Space Administration, Washington, D. C.
KAPPA-9M ROCKETS
Hideo Itogawa *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 75–76 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa-9M rocket for space observation is described. It is stated to be an improved version of the Kappa-8 rocket which was the standard vehicle for space observations in the Japanese space program. J.M.D.

N65-18809* National Aeronautics and Space Administration, Washington, D. C.
NOS. 8 AND 9 ROCKETS OF KAPPA-8 TYPE
Akio Tamaki and Shigebumi Saito *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 77–80 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa-8-8 and Kappa-8-9 observation rockets are described as part of the Japanese space program. Length, total weight, payload weight, and nose cone instruments for ionosphere probes, are listed for each rocket. Cross sectional drawings of the rockets are given. J.M.D.

N65-18810* National Aeronautics and Space Administration, Washington, D. C.
KAPPA-8-10 ROCKET
Tamiya Nomura and Daikichiro Mori *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 81–84 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The launch failure of a Kappa-8-10 rocket was investigated. Movie and sound records of the launch were studied, along with recovered parts of the nozzle, booster engine, and propellant chamber. J.M.D.

N65-18811* National Aeronautics and Space Administration, Washington, D. C.
K-8-11 ROCKET
Shigebumi Saito and Akio Tamaki *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 85–86 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa-8-11 rocket and its test flight are described. The purpose of the rocket in the Japanese space program is to measure ionospheric cosmic radiation, and radio noise propagation. Rocket length is 10926 mm; total weight is 1499 kg; nose cone instruments include telemeter transmitter, radar transponder, and Geiger counters. Data are presented on rocket performance in flight test, which indicate that the rocket is suitable for the above purposes. J.M.D.

N65-18812* National Aeronautics and Space Administration, Washington, D. C.
KAPPA 8L-1 TYPE SPACE ROCKET
D. Mori and T. Nomura *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 87–89 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa-8L-1 rocket design and test launch data are presented. The rocket is one of a series of rockets used in gaining ionospheric data in the Japanese space program. Payload instruments include teletransmitter, radar transponder, decelerometer, accelerometer, thermometer, and strain gage. J.M.D.

N65-18813* National Aeronautics and Space Administration, Washington, D. C.
KAPPA 9L-2 TYPE SPACE ROCKET
D. Mori and T. Nomura *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 90–92 ref (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Kappa-9L-2 three-stage rocket design and test flight data are presented. The rocket was designed to measure the density and temperature of the electrons in the ionosphere, as part of the Japanese space program. Rocket length is 12774 mm; total weight is 1591 kg; and payload instruments include teletransmitter, radar transponder, ionosphere detector, and normal component accelerometer. In test flight, the three stages worked well; ionospheric observations faded at 40 seconds from launch, but all other functioned until 160 seconds. J.M.D.

N65-18814* National Aeronautics and Space Administration, Washington, D. C.
KAPPA 9M-1 TYPE SPACE ROCKET
C. Tamaki and N. Saito *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 93–95 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Design and flight test data are given for the Kappa-9M-1 rocket. It is one of a series of Kappa rockets in the Japanese space program for gaining ionosphere data. The Kappa-9M-1 is a medium size rocket, with a relatively heavy payload of fifty kg, designed to reach an altitude of 350–400 km. Rocket length is 11174 mm; 1439 kg is total weight; and the nose cone payload includes an accelerometer, thermometer, and a strain gauge. J.M.D.

N65-18815* National Aeronautics and Space Administration, Washington, D. C.
AERODYNAMIC CHARACTERISTICS OF K-8L AND K-9M TYPE SPACE ROCKETS
F. Tamaki and S. Mitsuishi *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 96–100 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The Kappa-8L and Kappa-9M rockets described are two in a series of Kappa rockets in the Japanese space program for gaining ionospheric data. Low-speed wind-tunnel tests were done on stretched-out telemetry antennas on the exterior of the rocket; results suggest that the antennas do not affect the lift, drag, and moment coefficients. J.M.D.

N65-18816* National Aeronautics and Space Administration, Washington, D. C.
PERFORMANCE CALCULATIONS OF KAPPA-8L,-8,-9L, -9M TYPE SPACE ROCKET
R. Akiba, H. Hirozawa, and A. Kitasaka *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 101–111 refs (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Equations are given for computer computation of flight performance of various Kappa rockets. These differential equations describe the two-dimensional motion of a rocket at the outer circumference of the earth. Computations show that for Kappa-9 rockets it is feasible to ignore the rotational effect of the earth, but not for rockets of higher velocity. It was also found that for Kappa-9M rockets the rotational effect of the earth is much larger than the wind or changes of rocket axis. Calculated trajectories, and acceleration and velocity curves during flight, are given for various Kappa-8 and Kappa-9 rockets in the Japanese space program. J.M.D.

N65-18817# National Aeronautics and Space Administration, Washington, D. C.
STRUCTURAL STRENGTH OF KAPPA-8L AND -9M TYPE SPACE ROCKETS
Daikichiro Mori and Noboru Vakano *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 112–114 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Structural strength is discussed in Kappa-8L and Kappa-9M rockets in the Japanese space program. Propellant chamber, booster tail, and main rocket cylinder, are mentioned. Problems in ground-testing a sequence of Lambda engines are outlined. J.M.D.

N65-18818* National Aeronautics and Space Administration, Washington, D. C.
SMALL TYPE ROCKET
Fusao Tamaki, Okichiro Tamaki, and Iwaho Yoshiyama *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 115–120 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

A variety of small one- and two-stage testing rockets are described. They were used in development of Kappa rockets in the Japanese space program. Particular uses, are listed, which include testing of engines, propellants, structural strength, electronic systems, performance, and safety and control systems. J.M.D.

N65-18831* National Aeronautics and Space Administration, Washington, D. C.
SAFETY OPERATIONS AND THE SO-150 TYPE ROCKET
Tamiya Nomura, Iwaho Yoshiyama, and Hi-iro Nakamura *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 225–232 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Rocket safety devices are described: (1) a detector for sensing combustion malfunction in first-stage rocket, and (2) a system controlled at the ground station for cutting off second-stage ignition power. Also presented is an outline of the circuit for an electronic timer for igniting the second-stage engine at a predetermined time. Flight test data on safety and reliability of these devices were inconclusive. J.M.D.

N65-18837* National Aeronautics and Space Administration, Washington, D. C.
THE NOSECONE OPENING SYSTEM
Muneo Itabashi, Iwaho Nakamura, and Iwaho Yoshiyama *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 257–262 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

Instruments for atmospheric observations are placed in a rocket nose cone and carried to the upper atmosphere. The outside wall of the nose cone is removed when it is not needed. Its function is to protect the instruments from outside force and friction heat until the rocket escapes from the layer of air around the earth. The nose cone opening process is as follows: The actuator gets its signal from the opening delay tube, then starts to function. The black powder in the actuator is ignited, and the piston is pushed out. The shear pin in the split pin is broken and the nose cone is opened. When the nose cone separates from the rocket, the relative velocity of the nose cone with respect to the rocket is zero, and the cone gradually flies away in a direction normal to the rocket. R.W.H.

N65-18845* National Aeronautics and Space Administration, Washington, D. C.
MEASUREMENT OF ORIENTATION WITH K-8-11 TYPE SPACE ROCKET
Ai-o Kato, Iwaho Aoyama, Yoshio Simizu, and Tadashi I-zuka *In its* Surv. of Japan. Space Program with Emphasis on Kappa and Lambda Type Observation Rockets Feb. 1965 p 316–323 (See N65-18801 09-31) CFSTI: HC $7.00/MF $2.25

The rocket orientation measuring system described is a frequency-modulation magnetometer. The operating characteristics of the device and ground test results are presented. Launch test results indicate that there are unexpectedly wide variations in the rocket attitudes. This finding demonstrates the importance of rocket orientation measurement. Subsequent research will be directed toward reducing the size and weight of the measuring device and analyzing the data more rapidly and accurately using an electronic computer. R.W.H.

N65-18909*# National Aeronautics and Space Administration, Washington, D. C.
[PROGRESS IN THE LUNAR MANNED SPACE FLIGHT PROGRAM] News Release
George E. Mueller [1964] 21 p Presented at the Ann. Awards Banquet of the Aviation/Space Writers Assoc., Miami, Fla., 28 May 1964

Dr. George E. Mueller, Associate Administrator for Manned Space Flight, NASA, discussed general progress in the Gemini and Apollo programs. Particular emphasis was placed on J-2 and F-1 rocket engine development, launch vehicle and capsule structures, and useful information on meteoroids gained from the Explorer XVI satellite. Medical experiments, life support systems, and human performance studies for crew safety are described. E.P.V.

N65-18936*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
COMPILATION OF CALIBRATION DATA FOR AEROBEE FLIGHT 4.13 GP-GT
L. C. Castagnola Mar. 1965 54 p
(NASA-TM-X-55175; X-671-65-96) CFSTI: HC $3.00/MF $0.50

A compilation of calibration data and curves for instrumentation aboard the aerobee 150A rocket, together with the corresponding telemetry channel allocations is presented. The instrumentation payload consisted of pressure and temperature transducers, solar aspect sensors, magnetometers, and a pitch-yaw ogive. This information is supplied for reduction of the acquired raw data. G.G.

N65-18958*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
SWEDEN OPERATIONS, 1962
C. B. Tackett Feb. 1965 67 p
(NASA-TM-X-55174; X-671-65-66) CFSTI: HC $3.00/MF $0.75

A major reason for the study of noctilucent clouds is that a knowledge of inner space is prerequisite to the development of spacecraft for the near-earth and far regions of space. The precision and validity of the information derived from the studies of inner space are dependent, in a large measure, upon the sounding rocket programs. This report covers the work for the 1962 rocket firing in Sweden of the sounding rocket instrumentation section and is concerned chiefly with the problems, successes, and failures involved in telemetry instrumentation. A mobile telemetry ground station was specially instrumented with equipment that operated on 50 cps as well as 60 cps to meet Swedish power requirements. Author

N65-18959*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
INSTRUMENTATION REPORT ON NIKE APACHE FLIGHT 14.127 GI
R. W. Conrad and J. W. Cameron Oct. 1964 26 p
(NASA-TM-X-55172; X-671-64-298) CFSTI: HC $2.00/MF $0.50

This report is one of a series issued by the Sounding Rocket Instrumentation Section. The instrumentation and telemetry results of Flight No. 14.127 GI, fired from Wallops Island on July 16, 1964, are discussed. All pertinent engineering data on the actual flight instrumentation are included. The experiment carried by this vehicle measured impedance characteristics of radiating sensors for support of future space radio astronomy missions. Author

N65-19272*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

DESCRIPTION AND OPERATION OF SPACECRAFT SERT I ION THRUSTOR FLIGHT TEST

Harold Gold, Raymond J. Rulis, Frank A. Maruna, Jr., and William H. Hawersaat Washington, NASA, Mar. 1965 19 p refs

(NASA-TM-X-1077) CFSTI: HC $1.00/MF $0.50

The SERT I spacecraft was flown into a ballistic trajectory on July 20, 1964, by the Scout launch vehicle. The trajectory provided an experimental period of 47 minutes, during which the altitude of the spacecraft was above 250 nautical miles. The spacecraft carried two small ion thrustors and telemetered measurements of all major thrustor operating parameters. One of the thrustors operated for approximately 30 minutes, during which time the measured thrust verified the establishment of a neutral ion beam. Author

N65-19282*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

RESULTS FROM SERT I ION ROCKET FLIGHT TEST

Ronald J. Cybulski, Daniel M. Shellhammer, Robert R. Lovell, Edward J. Domino, and Joseph T. Kotnik Washington, NASA, Mar. 1965 43 p refs

(NASA-TN-D-2718) CFSTI: HC $2.00/MF $0.50

Two ion thrustors were programed to operate sequentially during the flight. One of these, a contact ion thrustor, could not be started because of a high-voltage electrical short circuit. The other thrustor, which was of the electron-bombardment type, operated as expected for a total of 31 minutes and 16 seconds during the flight. The primary flight objective of confirming neutralization of a high-perveance ion beam was attained. Ion beam thrust was measured with three independent thrust measuring systems. All voltages, currents, and other operating characteristics of the electron-bombardment thrustor were close to the nominal values obtained in previous vacuum tank tests. Telemetry data indicated no noticeable radio-frequency interference generated by the ion beam. Furthermore, all commands between the ground transmitter and spacecraft were transmitted and executed without interference. Author

N65-19285*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

AN ON-OFF CONTROL SYSTEM FOR A ROTATING MANNED SPACECRAFT

Peter R. Kurzhals and John G. Shearin Washington, NASA, Mar. 1965 30 p refs

(NASA-TN-D-2726) CFSTI: HC $2.00/MF $0.50

A pulse-jet damping and attitude control system suitable for a rotating manned spacecraft was investigated. The pulse-jet stability system was simulated analytically in the nonlinear equations of motion for the spacecraft; and the efficiency of the stability system in controlling the spacecraft wobble and attitude is determined by digital integration. To give physical significance to the results, typical motion time histories are presented for a large-diameter symmetric space station. In addition, the time to damp and the fuel required by the stability system are given for a range of system variables and spacecraft inertias. The pulse-jet system is capable of rapidly minimizing any spacecraft wobble resulting from applied disturbances, such as crew motions and docking torques, to a steady spin about the spacecraft principal maximum or minimum axis of inertia. The system is also capable of readily reorienting the spinning spacecraft and can thus serve for combined attitude control and wobble damping. Author

N65-19329# Sandia Corp., Albuquerque, N. Mex. Sandia Lab.

ENVIRONMENTAL TESTING OF THE RFD-2 RE-ENTRY VEHICLE

D. L. Krenz Feb. 1965 37 p ref

(SC-DR-64-1741) CFSTI: $2.00

The development, flight qualification, and flight acceptance tests of the RFD-2 reentry vehicle are discussed. The development tests were those which demonstrated the feasibility of early design concepts and the structural integrity of the early design under certain environmental conditions. During the flight qualification tests, the two reentry vehicles in flight-ready configuration were subjected to environmental testing representing the most severe conditions to be expected during the flight test. The flight acceptance tests were designed to uncover any structural defects in the units or any fault electronic equipment in the telemetry systems. No malfunctions or structural faults were found in the two units tested. E.E.B.

N65-19559*# National Aeronautics and Space Administration, Washington, D. C.

TIROS

[1965] 1 p Supersedes NASA Facts-B-2-64

(NASA Facts, Vol. II, No. 12; NASA Facts-B-2-64) GPO: $0.50

The National Aeronautics and Space Administration describes the construction, operational program, and mission profiles of the orbiting weather satellites in the Tiros series. Photographs transmitted by the satellite cameras indicated the presence of jet streams, regions of moist and dry air, thunderstorms, weather fronts, and many other types of cloud patterns. Information from Tiros III, processed by command and data acquisition stations gave early warning of an approaching hurricane, and the 5-day advanced weather predictions resulted in savings for agriculture, lumber industry, surface transportation, retail marketing, and resources management. G.G.

N65-19593*# National Aeronautics and Space Administration, Washington, D. C.

NASA SCHEDULES LAUNCH OF RADIATION-DETECTION SATELLITE THIS MONTH

7 Dec. 1964 26 p

(NASA News Release-64-302)

Detailed plans for a probe of the Van Allen belt were presented. The probe by an Energetic Particles Explorer D radiation-detection satellite was intended to yield data on how high-energy electrons and protons are injected, trapped, and eventually lost in the radiation belts. The project included observation of the distribution of particles in the belts, measurement of earth's magnetic field, and evaluation of damage to solar cells mounted on the satellite. J.M.D.

N65-19674# Royal Aircraft Establishment, Farnborough (England).

THE PERFORMANCE OF THE E.L.D.O. SATELLITE LAUNCHING VEHICLE IN THE "THRUST-COAST-IMPULSE" MODE OF INJECTION (7500 nm CIRCULAR POLAR ORBIT)

J. B. Scott Nov. 1964 48 p refs

(RAE-TR-64059)

The performance of a satellite-launching vehicle, when injecting payloads into a polar circular orbit of 7500-nm altitude, was studied. The assumed mode of injection consists of using the third stage to inject the vehicle into a transfer ellipse having a perigee of low altitude, and an apogee at the altitude

of the required orbit. After coasting up the transfer ellipse to its apogee, the third stage is relit to effect the injection of the satellite into the required orbit. The second period of burning of the third stage is assumed impulsive, since this gives a good approximation to the real trajectory. The effect on performance of varying the parameters of the transfer ellipse was investigated, and the results were used to deduce the effects of some of the practical limitations of the launching system. The effect on performance arising from the use of a parking orbit was also investigated, and the variation of payload due to varying the altitude of the parking orbit is given. Author

N65-19764*# National Aeronautics and Space Administration, Washington, D. C.
THE ROLE OF RESEARCH IN MANNED SPACE FLIGHT
John L. Sloop [1964] 36 p Lecture to Santa Clara County Sci. Teachers, Ames Research Center, 22 Oct. 1964
(NASA-TM-X-56144) CFSTI: HC $2.00/MF $0.50

The rapid growth of science and technology in recent years with its resulting impact on the lives of all Americans was the heart of the speech presented by John L. Sloop, NASA. Energy conversion, materials, structures, guidance, navigation, communications, life support systems, human factors, and other aeronautical areas are mentioned. The transfer of information and education was highlighted. The teacher, the scientist, and the engineer must be adaptable to the changes in science and technology brought on by their contributions. The teacher has the additional responsibility of equipping the pupil not with practices or procedures that will be outmoded quickly, but with the basic scientific and engineering tools that he needs to adjust to the rapid changes, and to thrust forward for new contributions. E.E.B.

N65-19799*# National Aeronautics and Space Administration, Washington, D. C.
BIOSATELLITES
[1965] 8 p
(NASA Facts, Vol. II, No. 10) GPO: $0.15

The National Aeronautics and Space Administration presents an outline of the construction, function and programs of the earth-orbiting biological satellites to be launched in early 1966. These satellites will carry plant and animal specimens, single cells, and complex organisms to study the effects of weightlessness, radiation, weightlessness combined with radiation, and the absence of the effects of the earth's rotation, such as the removal of the normal 24-hour day and night cycle. Six flight programs will carry out experiments for the three major payload categories of radiation, general biology and biorhythm, and primates. G.G.

N65-19840*# National Aeronautics and Space Administration, Washington, D. C.
BEACON EXPLORER-C USES 'TRAIN WHISTLE EFFECT' IN EARTH MEASUREMENT
26 Mar. 1965 21 p
(NASA News Release-65-97)

The Beacon Explorer-C (BE-C), the first NASA satellite with geodesy as its primary mission, is discussed. The train whistle effect, which refers to the Doppler shift in frequency of a sound or radio wave received from a moving source, is explained. This satellite will be equipped to evaluate further the use of laser techniques in deriving orbital and geodetic information, and for deep space communication. The scientific objectives of geodesy, surveys of the ionosphere, electron density, and temperature, laser experiment, and radio attenuation experiment are described. A fact sheet on the satellite is included. E.E.B.

N65-19844*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
IMP D&E FEASIBILITY STUDY
Paul G. Marcotte Jan. 1964 148 p refs
(NASA-TM-X-55166; X-672-64-4) CFSTI: HC $4.00/MF $1.00

Feasibility study is reported which shows that a 181-lb Interplanetary Monitoring Platform spacecraft (IMP D & E) can be placed into a gravitationally anchored orbit about the moon by a thrust augmented Delta (TAD) vehicle with a third-stage and kick-motor retrorocket for lunar injection. Detailed information is given on the spacecraft, its subsystems, information processing system, and the ground system; the flight plan is described. The purposes of the IMP D & E project are described: gathering data on lunar environment with respect to energetic particles, cosmic rays, cosmic dust, and magnetic and gravitational fields. Theoretical calculations in the improved nominal trajectory case revealed a 90% probability of achieving a stable lunar orbit; in 100 Monte Carlo computer trial orbits, 58 had an orbit lifetime of 180 days or more. J.M.D.

N65-19920*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPARISON OF DIRECT AND INDIRECT ASCENT MODES FOR THE 1966-1967 MARS OPPORTUNITY WITH AN ATLAS-CENTAUR LAUNCH VEHICLE
Tim J. Kreiter Washington, NASA, Mar. 1965 22 p refs
(NASA-TN-D-2739) CFSTI: HC $1.00/MF $0.50

A study was made of the feasibility of using a direct ascent Atlas–Centaur booster to launch a flyby spacecraft to Mars during the 1966–1967 period. To evaluate the effectiveness of the direct ascent launching mode, daily launch windows and payloads were computed for both direct and indirect ascent trajectories and the two modes were compared on the basis of total number of launch opportunities and payload capability. In this study, type I interplanetary transfer conics (heliocentric angles less than 180°) were investigated over a 3-month firing interval. A launch azimuth envelope of 90° to 114° was assumed, and a minimum daily launch window requirement of 60 minutes was imposed. The direct ascent trajectories were selected such that the declination of the outgoing asymptote equaled the negative of the launch site latitude since this yielded near-maximum payloads. Indirect ascent trajectories were selected such that the daily launch energies were minimized. Launch windows were developed by varying injection flight path angle for direct ascent trajectories and by varying parking orbit coast time for indirect ascent trajectories. The direct ascent mode was found not only feasible for a 1966 Mars flyby mission but also superior to the indirect ascent mode insofar as payloads and number of opportunities are concerned. Author

N65-20108*# National Aeronautics and Space Administration. Goddard Space Flight Center
SATELLITE SITUATION REPORT, VOLUME 5, NO. 2
31 Jan. 1965 17 p
(NASA-TM-X-56185; X-533-63-1) CFSTI: HC $1.00/MF $0.50

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N65-18634# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATIONS IN THE STABILITY OF TURBINE VANE MATERIALS
Ye. P. Unksov, ed. 17 Jun. 1963 188 p refs Transl. into ENGLISH of the book "Issledovaniye Prochnosti Materialov Lopatok Turbin" Moscow, Gos. Nauchn.-Tekhn. Izd. Mashinostr. Lit., 1961 p 1–167
(FTD-TT-62-1817/1+2; AD-413590)

This collection is intended for engineers and technical workers in research, plant laboratories, and turbine works, and contains the results of various studies on the durability of gas turbine vanes operating at high temperatures. Discussed are fatigue resistance tests in heat-proof materials to prove the dependence of the rupture stress amplitude upon the level of normal tensile stress; improvement in the properties of root fastenings in turbine vanes; structural strength in vanes and models by fatigue tests under simultaneous normal tensile load; dynamic calibration of tensometric gauges for vibration strain in conditions similar to turbine operation, and the design of an experimental test apparatus for this purpose; gauging errors in high temperature tensometry and methods for their minimization; blade failure analysis of an experimental gas turbine; the influence of temperature cycles on metal strength and deformation and crack origination due to thermal fatigue; a new experimental gas turbine for testing blades under different stresses and temperatures; a machine to test seven vane models simultaneously for fatigue; and methods and findings when blades are subjected to erosion by ash-laden gas streams. G.G.

N65-18797# Naval Research Lab., Washington, D. C.
A NAVY ANALYSIS OF GLASS REINFORCED PLASTICS FOR HYDROSPACE APPLICATIONS
J. A. Kies Nov. 1964 39 p refs Presented at the Northeastern States Navy Res. and Develop. Clin., Philadelphia, 19 Nov. 1964
(AD-609708)

Single-loading and fatigue test results are presented for glass-fiber-reinforced plastic (grp) shells in compression. Average compressive strength of 150 000 psi is easily obtainable, with top strengths of 170 000 psi, in nonbuckling cylinders designed for deep submergence. Preliminary design of a submarine hull was performed, using an equivalent stress method. This indicates the feasibility of a grp submarine capable of a single dive of 20 000 ft, with a safety factor of 1.5, and a buoyancy factor of 0.4. Fatigue, port design, moisture effects, and fiber prestressing are discussed, and other problem areas limiting practical design are listed. E.P.V.

N65-18962# Northrop Corp., Hawthorne, Calif. Norair Div.
EMPIRICAL CORRELATION OF EXCITATION ENVIRONMENT AND STRUCTURAL PARAMETERS WITH FLIGHT VEHICLE VIBRATION RESPONSE Technical Report, May 1962–Jul. 1964
R. W. White, D. J. Bozich, and K. M. Eldred Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Dec. 1964 138 p refs
(Contract AF 33(657)-8218)
(NOR-64-226; AFFDL-TR-64-160; AD-610482)

The design of fatigue-resistant structures for high speed aircraft and aerospace vehicles depends largely on the prediction of realistic acoustic, fluctuating-aerodynamic, and engine-vibration environments, and on the estimation of the attendant vibration levels of structural components and attached equipment. In this report, a definitive statement is presented of the empirical approach for determining correlations between the excitation environment and the vibration response of typical flight vehicle structures by means of statistical analyses of measured vibration data. The various aspects of the vibration prediction problem and the general philosophy motivating research in the area of empirical correlation are discussed. Specific treatment is given to the effects of bandwidth, modal density, and surface pressure spacecorrelation on the cross correlation of energy transmitted along various structural transmission paths in complex linear structures. An engineering model for empirical correlation is developed and several examples are given. Author

N65-19006# Allied Research Associates, Inc., Boston, Mass.
THERMOELASTIC STRESS CONCENTRATIONS
Frederick Bird and Herbert Becker Feb. 1965 53 p refs
(Contract AF 33(615)-1241)
(ARA-F-257-12; AFFDL-TDR-64-173; AD-611534)

Thermal stress concentration factors were determined for rectangular flat plates, some of which were penetrated by holes and some which had filleted width changes. The experimental data indicate that the thermal stress concentration factors would be less than tension stress concentration factors for the same bars. Additionally, the peak thermal stress was found to be smaller in magnitude than the nominal applied thermal stress, except for one case in which the peak stress at the hole was 1.2 times the applied stress. Author

N65-19011# California Inst. of Tech., Pasadena. Firestone Flight Sciences Lab.
A REVIEW OF RECENT INVESTIGATIONS INTO FRACTURE INITIATION AT GALCIT, DECEMBER 1960–JUNE 1964
J. L. Swedlow and M. L. Williams Wright-Patterson AFB, Ohio, ARL, Oct. 1964 136 p refs
(Contract AF 33(616)-7806)
(ARL-64-175; AD-610078)

The effects of initial curvature were explored through analysis of a finite length crack in both a spherical cap and a cylindrical shell. Elastic results indicate that curvature tends to increase notch sensitivity, and these results were used to derive approximate fracture criteria. Linear and nonlinear interaction formulas were proposed for applied extension and bending and compared to preliminary experimental results. The effect of plasticity was examined qualitatively, various experimental and numerical results were collected and compared, and a semitheoretical ductile fracture criterion which includes work hardening was derived. Considerable experimental evidence dealing with the thickness effect was reviewed, and certain of the basic phenomena were identified. Some attempt was made to examine the nature of the stress state near the crack tip, based on classical elasticity, with the apparent result that the transverse stresses are not singular. Author

N65-19029# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EQUILIBRIUM OF FLEXIBLE ELASTIC-PLASTIC SHELLS AND PLATES
M. F. Yershov 25 Nov. 1964 14 p refs Transl. into ENGLISH from Prikl. Mekhan. (Ukraine), v. 8, no. 5, 1962 p 489–499
(FTD-TT-64-420/1+2; AD-609786)

A discussion is given of the basic equations of the theory of flexible elastic-plastic shells, in which the dimensions of the bulges formed during deformations are small in comparison with the curvature radii. Initially flat rectangular plates are then considered that have free support of their edges and that are deformed along one edge to tend to form parallelograms. Areas of plastic and elastic deformations are discussed, and formulas are derived that lead to Bubnov-Gal'ernik equations. D.E.W.

N65-19082# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THEORETICAL WEIGHT-FORMULA OF TAPERED WINGS
N. N. Fadeyev 2 Feb. 1965 26 p refs Transl. into ENGLISH from Metody Priblizhennykh Raschetov i Vybora Parametrov Pri Proektirovanii Samoletov, Tr. Inst., (Moscow), no. 138, 1961 p 28–47
(FTD-TT-64-802/1+2; AD-611013)

Formulas developed for the determination of the weight of aircraft spar flanges, and other stressed structural elements of the tapered wing such as ribs, nose, tail, cowling, flaps, and ailerons, are presented. Experiments showed that correction factors to be applied to the theoretical formulas fluctuate widely in value for individual elements, but do not fluctuate for the total weight of all elements. This is due to the interaction between individual elements. An increase in weight in one element allows a decrease in weight in some other. A formula is also given for the calculation of the volume of fuel to be located in the aircraft wing. E.E.B.

N65-19094# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
AXISYMMETRIC REINFORCED VISCOELASTIC CYLINDRICAL SHELL
M. Shinozuka and W. R. Spillers Dec. 1964 31 p refs
(Contract Nonr-266(78))
(TR-26; AD-610856)

Available methods for determining the mechanical properties of a reinforced material in terms of the mechanical properties of the constituents are discussed. A solution is then presented to the problem of an axisymmetric thin cylinder formed by reinforcing a viscoelastic filler with elastic reinforcement. Author

N65-19101# Bell Aerosystems Co., Buffalo, N. Y. Aerospace Engineering Dept.
DEVELOPMENT OF A PROCEDURE FOR AUTOMATED SYNTHESIS OF MINIMUM WEIGHT STRUCTURES Technical Documentary Report, 1 Jul. 1963–31 Aug. 1964
R. A. Gellatly, R. H. Gallagher, and W. A. Luberacki Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 101 p refs
(Contract AF 33(657)-11748)
(FDL-TDR-64-141; AD-611310)

This report presents the development, application, and evaluation of an automated approach to minimum weight structural design. A computer program based on this approach is described; examples are given of the design of truss, frame, and stiffened plate structures; and projections are made of the efforts required in application of the procedure to major airframe components. An approach to the inclusion of instability effects in the design process is developed. Specific recommendations for future developmental work and applications are presented. Author

N65-19103# Stevens Inst. of Tech., Hoboken, N. J. Davidson Lab.
STUDY OF THE DESIGN AND BEHAVIOR OF A HYDROFOIL SEMI-SUBMARINE
E. M. Uram Aug. 1964 84 p refs
(Contract Nonr-263(10))
(R-1023; AD-608109)

The results of a study of an unusual ship design in the 3000-ton class for high-speed operation in rough waters are presented and discussed. The hydrofoil semisubmarine is a shallow-running submersible with an Albacore-type main hull incorporating a surface-piercing dihedral hydrofoil system. The information and techniques used to arrive at a selection of an ehp-optimized hull form, the placement of the dihedral foil and stern planes and a preliminary examination of the ship's stability are described. Details of the model construction and of test apparatus, procedures, and conditions are presented. Results of a comprehensive program of restrained-model tests are presented and analyzed. Results of motion tests in three degrees of freedom (pitch, heave, and surge) in calm and regular ahead and following seas are presented and discussed, and compared with similar information concerning a destroyer and other unusual ship forms. Author

N65-19108# Brown Univ., Providence, R. I. Div. of Applied Mathematics
MECHANICS OF RATE-INDEPENDENT MATERIALS Technical Report No. 95
A. C. Pipkin and R. S. Rivlin Nov. 1964 32 p refs
(Contract Nonr-562(10))
(C11-95; AD-608641)

Constitutive equations for finite deformations of rate-independent materials with memory are discussed. The Piola stress is taken to be a functional of the path of deformation in strain space, independent of the rate of traversal of this path. The restrictions on the form of this functional arising from initial isotropy are exhibited. Differential and integral approximations to the functional are considered. A general theory of elastic-plastic materials, i.e., rate-independent materials with an elastic range, is formulated. Author

N65-19109# Illinois Univ., Urbana. Dept. of Theoretical and Applied Mechanics
STRESS DISTRIBUTION IN A NOTCHED SEMI-INFINITE PLATE
D. Shadman Aug. 1964 49 p refs
(Contract Nonr-2947(02)(X))
(T&AM-267; AD-608932)

The problem treated in this paper is that of determination of stresses in a semi-infinite elastic half-plane with a notch of depth unity perpendicular to the straight edge. The half-plane is loaded symmetrically with two isolated forces acting at points inside the semi-infinite body. The solution to this problem is obtained by superposition of stresses due to (a) complete elastic half-plane loaded with two isolated forces, located symmetrically with respect to a line perpendicular to the straight edge, and (b) notched elastic half-plane with prescribed stresses acting on the boundary of the notch. The prescribed tractions on the notch are obtained from the solution of part (a). The numerical values of the stress-intensity factors for 62 different locations of the isolated forces in the half-plane are determined. These results generally indicate a sharp change in the stress-intensity factors when the forces act at points close to the crack. The change of the stress-intensity factor is small when the forces act at points several crack lengths removed from the crack. Author

N65-19123# General Technology Corp., Torrance, Calif.
AN APPROXIMATE EXPRESSION FOR THE STRESS CONCENTRATION IN A CIRCULAR CYLINDRICAL SHELL WITH A CIRCLE CUTOUT
A. K. Naghdi and A. C. Eringen Aug. 1964 36 p refs
(Contract NObs-78866)
(TR-3-5; AD-610523)

An approximation to the stress function, by use of which the stresses and the stress concentration factors of a circular cylindrical shell with a circular cutout can be calculated, is

presented. The analytical solution is achieved by representing the stress function coefficients in an infinite series of terms containing the material-geometry parameter. Considered are the following three loading cases: (1) a uniformly distributed bending moment around the edge of the cutout; (2) a uniform longitudinal tensile load with the edge of the cutout stress-free; and (3) a uniform internal pressure equilibrated by a uniform transverse shear at the edge of the cutout. G.G.

N65-19141# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON FREE OSCILLATIONS OF A CIRCULAR CYLINDRICAL AND HOLLOW SHELLS REINFORCED BY A NETWORK OF RIBS

M. O. Nazarou 28 Jan. 1965 13 p refs Transl. into ENGLISH from Prikl. Mekhan. (Ukraine), v. 9, no. 3, 1963 p 249–258

(FTD-TT-64-797/1+2; AD-610799)

The effect of a small number of longitudinal and transverse stiffening ribs on the free oscillations of a circular cylindrical and shallow shells is studied. The potential and kinetic energies of an elastic system consisting of shells and ribs are written by means of Dirac's δ functions. Differential equations of free oscillations of the stiffened shell are obtained from the Hamilton–Ostrogradsky variational principle. A feature of the differential equations is that their solutions have to satisfy only kinematic conditions on the ribs. The construction of these solutions does not differ from the construction of similar solutions for a smooth shell. Thus it becomes possible to apply the Bubnov–Galerkin method to shells reinforced by a small number of ribs. The case of a hinged-mobile support of the shell is discussed. On the basis of the formulas obtained, calculations are performed which make it possible to estimate the effect of the ribs on free oscillations of the shell. Author

N65-19199# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

STABILITY OF A LONG ORTHOTROPIC RIBBED CYLINDRICAL SHELL

Tadeusz Galkiewicz 26 Feb. 1965 16 p refs Transl. into ENGLISH from Zeszyty Naukowe: Mech., Lodz. Politechnika (Lodz), no. 51, 1963 p 21–32

(FTD-TT-64-747/1 + 2 + 3 + 4; AD-458246)

Approximate and relatively simple formulas for the stress and critical moments in the case of twisting of long orthotropic shells are presented. The continuity equation for an orthotrophic cylindrical shell is derived. E.E.B.

N65-19260# David Taylor Model Basin, Washington, D. C. Acoustics and Vibration Lab.

FORCED VIBRATION OF BEAMS AND FLUTTER OF BEAM-FOIL SYSTEMS

E. H. Kennard and Ralph C. Leibowitz Oct. 1964 101 p refs (DTMB-1848; AD-609499)

Equations are developed for two-dimensional harmonic transverse forcing at any point of an undamped uniform beam having bending and shearing flexibilities and for harmonic end forcing of a uniform beam having also external and internal damping. Variations of beam influence and inertia coefficients with frequency are discussed for an undamped beam without shear warping. Equations are also developed for the determination of the flutter speed of a rigid hydrofoil flexibly attached to such a beam. The flutter process is illustrated by a detailed discussion of two simple cases of flutter. Author

N65-19266*# Martin Co., Baltimore, Md. Space Systems Div.

DESIGN TECHNIQUES FOR STRUCTURE-CRYOGENIC INSULATION INTEGRATION

R. G. Hannah and O. J. Bush Huntsville, Ala., NASA. Marshall Space Flight Center, 25 Jan. 1965 220 p refs (Contract NAS8-5268)

(NASA-CR-61038) CSFTI: HC $6.00/MF $1.25

Design techniques and solutions for integrating highly efficient thermal insulations with cryogenic tankage for space vehicles are reported. A uniform basis for the development, evaluation, and comparison of the design solutions was provided by prescribing a typical but idealized set of conceptual design criteria for use in developing all insulation systems. Of the many investigated combinations of basic insulation materials, their augmentation, and their installation, six systems were selected for detailed consideration. Each is estimated to be capable of satisfactorily performing the conceptual mission. Preliminary designs are presented, and adaptations of one of the systems developed for the conceptual spherical tanks are shown for an integral cylindrical tank, and for a toroidal tank. E.E.B.

N65-19273*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.

NONMONOTONICITY IN SENSITIVITY TEST DATA

J. B. Gayle 22 Jan. 1965 13 p refs

(NASA-TM-X-53194) CFSTI: HC $1.00/MF $0.50

In general, the frequency of reactions for sensitivity test data of the "go-no-go" type increases monotonically with increasing levels of stimulus. However, occasional instances of nonmonotonic behavior have been noted. One such instance was investigated by carrying out a sufficient number of replicate tests to permit a statistical analysis of the data. The results indicated that over a considerable range of stimulus levels the frequency of response decreased significantly with increasing stimulus levels. The significance of this finding to sensitivity testing in general is discussed. Author

N65-19280*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

TECHNIQUES FOR EXAMINING STATISTICAL AND POWER-SPECTRAL PROPERTIES OF RANDOM TIME HISTORIES

Herbert A. Leybold Washington, NASA, Mar. 1965 45 p refs (NASA-TN-D-2714) CFSTI: HC $2.00/MF $0.50

A technique is presented for digitally generating random time histories having any desired shaped power spectra. Four random time histories having different statistical and power-spectral properties have been generated and analyzed to determine their instantaneous mean and amplitude distributions. In each, the distribution of instantaneous means could be approximated by a normal or Gaussian distribution, and the distribution of instantaneous amplitudes could be approximated by the sum of a Rayleigh distribution and a normal distribution. An attempt was made to relate the coefficients of the equations used to represent the distributions of means and amplitudes to the power-spectral properties of the generated time histories. Two of the coefficients could be related to the power-spectral properties of the time histories. The remaining two coefficients were empirically determined since no apparent relationship was found between these coefficients and the power-spectral properties of the generated random time histories. Author

N65-19283*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

INVESTIGATION OF DAMAGE TO BRITTLE MATERIALS BY IMPACT WITH HIGH-VELOCITY PROJECTILES INTO GLASS AND LUCITE

James H. Diedrich and Francis S. Stepka Washington, NASA, Mar. 1965 40 p refs
(NASA-TN-D-2720) CFSTI: HC $2.00/MF $0.50

The specimens were divided into two general classifications: thin targets that were completely penetrated by the projectile, and thick targets that were able to resist perforation. Glass and Lucite were employed as target materials to permit a rapid, visual qualitative examination of surface and subsurface damage details. The majority of the data were obtained by using 7/32-inch-diameter spherical aluminum projectiles traveling at about 6400 feet per second. The results indicated that the primary damage directly associated with the projectile penetration and crater damage is determined by the target and projectile material and the impact conditions. Secondary damage caused by the reflections and the interactions of the induced pressure waves was shown to be dependent upon the size and the shape of the target. The results also indicated that the method of target support, and the materials contacting the target boundaries can influence the extent of secondary damage. The use of appropriate backing materials reduced the extent of secondary damage in thick targets that were not completely penetrated by the projectile. Thin targets, however, generally exhibited an increase in secondary damage when backing materials were employed. Author

N65-19316# New Mexico Univ., Albuquerque. Mechanical Engineering Dept.
STUDY OF DISLOCATION FAILURE PHENOMENA IN UNIFORM RADIAL AND TENSILE FIELDS
F. D. Ju 20 Aug. 1964 73 p refs
(Grant AF-AFOSR-63-250)
(ME-10; AFOSR-64-1715; AD-609855)

Two states of plane elastic dislocation were studied. In one, dislocation patterns were the result of uniform radial stress fields. In the other, the dislocation cuts appeared in a uniaxial stress field. The uniaxial stress field yielded a predetermined pattern of dislocation cuts, but the radial stress field produced dislocation patterns of a more or less random order. The model of the radial stress field problem was a large plate bounded at the interior by a circular hole, and the model was subjected to a load that produced a uniform, radial tensile stress field with respect to the center of the hole, while the edge of the hole remained traction free. The model of the uniaxial tensile field problem was similar to the former model that had a center hole as a stress raiser. However, only a qualitative discussion of the design of models and the stabilization process is included for the second, since no model was found to arrest and stabilize the partial fracture while the region remained essentially elastic. D.E.W.

N65-19318 Illinois Univ., Urbana. Engineering Experiment Station
STUDIES OF THE BEHAVIOR OF HIGH-STRENGTH BOLTS AND BOLTED JOINTS
E. Chesson, Jr. and W. H. Munse Oct. 1964 43 p refs *Its* Bull. 469, Vol. 62, No. 28 Available from Illinois Univ.: $1.50

Extensive tests of individual bolts were made to evaluate the effect of washers on the clamping force developed in high-strength bolt assemblies tightened by a turn-of-nut method. Results indicate no significant difference in the clamping force of structural bolts, either with or without washers. A study of the changes necessary in the turn-of-nut method when the surfaces at the head and nut of the bolt were on 5% slopes indicates that additional turning is required to insure proper tightening. Fatigue tests were conducted to determine the effect upon joint life of omitting the washers from the bolt assembly. All specimens were four-bolt, double-lap, shear-type joints and included connections designed with either the inside or the outside plates critical. Specimens were generally assembled with 3/4-inch-diameter fasteners. From these and other test results, it appears that the fatigue lives of properly bolted joints assembled without hardened washers are generally as long as those of joints assembled with washers. Author

N65-19334# Bettis Atomic Power Lab., Pittsburgh, Pa.
AN INELASTIC CONTINUUM THEORY FOR DILATATING AGGREGATE MATERIALS
N. C. Small Feb. 1965 28 p refs
(Contract AT(11-1)-GEN-14)
(WAPD-TM-421) CFSTI: $2.00

The inelastic mechanical behavior of an aggregate material consisting of a weak void constituent exhibiting spontaneous dilatation embedded in a load-carrying matrix is described in terms of a suitably defined equivalent continuum. An existing inelastic continuum theory is modified to include the effects of compressibility and spontaneous dilatation. This theory is then related to the actual aggregate by assigning to each infinitesimal continuum element the desired gross or average behavior of a corresponding repeating finite aggregate element. Semirealistic analytical models are used to simulate the real compressibility and spontaneous dilatation effects. Emphasis is placed on steady-state creep behavior, and a clad solid sphere is used to illustrate the advantages and limitations of the theory. From this example it is tentatively concluded that, with proper care, realistic results may be achieved at least for gross deflection rates and stresses in the external constraints. Author

N65-19362# Minnesota Univ., Minneapolis. Dept. of Aeronautics and Engineering Mechanics
A CORRUGATED ADDITION FOR INCREASED DAMPING IN FLEXURE Technical Report, 15 Jun. 1960–15 Jun. 1964
P. J. Torvik and B. J. Lazan Wright-Patterson AFB, Ohio, AF Mater. Lab., Jan. 1965 60 p refs
(Contract AF 33(615)-1055)
(AFML-TR-64-373; AD-611810)

A new type of configuration having the general form of a corrugation is shown to be capable of dissipating large damping energy through cyclic shear in a viscoelastic adhesive layer. Expressions are derived for the energy dissipation in one particular form of this configuration. The optimum geometry for maximum damping is discussed with respect to several critical parameters. Corrugated configurations were constructed and tested to check the theory. Satisfactory agreement was found between the experimental results and the values predicted by the theory for shear strain in the viscoelastic layer, for the large increase in damping associated with the adhesive shear mechanism, and for the optimum thickness of the viscoelastic adhesive for maximum damping. As an indication of the increase in damping realized through the corrugated addition approach, the loss coefficient of an aluminum beam at a cyclic stress of 4000 psi was increased from approximately 0.01 to 0.2 by the corrugated addition. Author

N65-19363# Florida Univ., Gainesville. Dept. of Engineering Science and Mechanics
ON THE STRESSES IN A NONLINEAR BEAM SUBJECT TO RANDOM EXCITATION
Richard E. Herbert Aug. 1964 25 p refs
(Grant AF-AFOSR-62-313)
(AFOSR-64-1038; AD-606810)

The method of equivalent linearization is used to investigate the effects of the membrane force on the stresses in a simply supported Bernoulli–Euler beam subject to random

excitation. It is shown that, while the mean-square membrane stress is negligible compared to the mean-square bending stress, the former nevertheless has the effect of reducing the latter. Furthermore, this reduction is less significant for higher driving frequencies, thereby reducing any nonlinear safety factor that might be considered. Author

N65-19417# California Univ., Livermore. Lawrence Radiation Lab.
SOME THEORETICAL AND EXPERIMENTAL ASPECTS OF DESIGN WITH BRITTLE MATERIAL
Ernest Y. Robinson 3 Aug. 1964 106 p refs
(Contract W-7405-ENG-48)
(UCRL-7729)

The theory of strength of brittle materials, as advanced by Weibull, establishes the importance of tensile stress as the failure mechanism and the existence of a random distribution of flaws. The theory is reviewed, and certain new modifications and their applications are described. Tests were made with beryllium oxide tubes and the results compared with theory. Rules for the design of brittle materials are included. E.E.B.

N65-19426# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics
SECOND SEMINAR ON FATIGUE AND FATIGUE DESIGN
J. Branger (Flugwerk Emmen, Switzerland) Jun. 1964 98 p refs
(Contract Nonr-266(91))
(TR-5; AD-611414)

The fatigue history simulator, full-scale fatigue tests on the P-3 aircraft and the DH-112 Venom aircraft, and the fatigue safety of aircraft in service and its supervision were the subjects considered in the second seminar on fatigue and fatigue design. E.E.B.

N65-19490# Barry Controls Div., Barry Wright Corp., Watertown, Mass.
SIMULATION OF THE RESPONSE OF EQUIPMENT IN UNDERGROUND INSTALLATIONS TO BLAST INDUCED GROUND MOTIONS Report No. 102
Peter C. Calcaterra 30 Nov. 1964 185 p ref
(Contract DA-49-146-XZ-108)
(DASA-1549, AD-608531)

The characteristics of the response of isolated equipment installed in underground structures to the ground motions induced by nuclear blast are defined in terms of weapon yield, distance from blast, ground conditions, and natural frequency of equipment suspension. A design approach is proposed for a variable stiffness, multidegree-of-freedom device capable of generating the isolated equipment response motions. Pneumatic double-acting cylinders and elastomer springs are selected as the variable stiffness mechanism. Pneumatic rams are selected as the displacement mechanism. The performance characteristics of a model built using the proposed design approach are defined by means of acceleration-time traces of the motions generated for different values of oscillating frequency, load, and initial displacement. Conclusions and recommendations are made, based on comparison of the motions generated by the model to the expected response motion of isolated equipment in underground installations. Author

N65-19553# Hexcel Products, Inc., Berkeley, Calif.
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE Monthly Progress Report, Jul. 1964
E. C. Vicars 26 Aug. 1964 14 p
(Contract DA-04-200-AMC-477(A))
(MPR-7; AD-609871)

Two cases were subjected to vertical and longitudinal vibration tests, with no damage occurring. Frequency and acceleration are tabulated for significant peak values. In hydrostatic pressure tests, the first case leaked and the second one did not. The probable cause for the different results was leakage past the plastic seal ring which appeared to be faulty during the first tests, and was replaced before the second test. E.P.V.

N65-19564# Brown Univ., Providence, R. I. Div. of Engineering
EXTENDED DISPLACEMENT BOUND THEOREMS FOR WORK HARDENING CONTINUA SUBJECTED TO IMPULSIVE LOADING
J. B. Martin Oct. 1964 31 p refs
(Contract N189(181)-57827A(x))
(BU/DTMB/5; AD-609760)

Earlier work presenting a technique for bounding displacements following impulsive loading in inelastic continua is extended to give more powerful results for stable work-hardening materials. The extension is achieved by adding a self-evident statement regarding the material behavior to Drucker's postulate of stability for time-independent, path-dependent solids. Author

N65-19577# Army Materials Research Agency, Watertown, Mass.
THIN CYLINDRICAL SHELLS UNDER LOCAL AXIAL LOADINGS
John F. Mescall Dec. 1964 22 p refs
(AMRA-TR-64-39; AD-456337)

The linear equations due to Flügge for thin elastic circular cylindrical shells are solved by use of the finite Fourier transform for the case of distributed tangential (axial) loading with simply supported edge conditions. This solution supplements prior results obtained by Bijlaard for radial (normal) distributed loadings. Combining Bijlaard's results with the solutions obtained in this report permits discussion of localized loadings having components both normal and tangential to the shell's middle surface. Such an application is discussed and numerical results are provided. Author

N65-19580# Bell Aerosystems Co., Buffalo, N. Y. Aerospace Engineering Dept.
DEVELOPMENT OF A PROCEDURE FOR AUTOMATED SYNTHESIS OF MINIMUM WEIGHT STRUCTURES Technical Documentary Report, 1 Jul. 1963–31 Aug. 1964
R. A. Gellatly, R. H. Gallagher, and W. A. Luberacki Oct. 1964 97 p refs
(Contract AF 33(657)-11748)
(FDL-TDR-64-141; AD-611310)

This report presents the development, application, and evaluation of an automated approach to minimum weight structural design. A computer program based on this approach is described; examples are given of the design of truss, frame, and stiffened plate structures; and projections are made of the efforts required in application of the procedure to major airframe components. An approach to the inclusion of instability effects in the design process is developed. Specific recommendations for future developmental work and applications are presented. Author

N65-19581# Army Engineer Waterways Experiment Station, Vicksburg, Miss.
MODEL STUDY OF A BURIED ARCH SUBJECTED TO DYNAMIC LOADING
R. K. Tener (Ph.D. Thesis–Iowa State Univ. of Sci. and Technol.) Nov. 1964 179 p refs Sponsored by DASA
(TR-1-660; AD-452104)

This study investigated a modeling procedure for predicting the elastic behavior of a laboratory-size prototype buried arch structure subjected to a dynamic surface overpressure. Design conditions and prediction equations were formulated using similitude theory based on dimensional analysis. Five geometrically similar, semicircular aluminum arches with diameters ranging from 8 to 24 inches were used as test structures to experimentally verify the model theory. Dynamic tests on the buried structures were conducted in a dense dry sand medium. Sixteen dynamic shots at peak overpressures of 30 to 220 psi were conducted for two different scaled depths of cover over the structures. Peak dynamic strains and deflections from five structures were compared. The test results clearly verified the model theory for the range of parameters investigated. Author

N65-19657# California Univ., Livermore. Lawrence Radiation Lab.
PLANE STRESS PROBLEMS IN THE MATHEMATICAL THEORY OF ELASTICITY
Maurice Zaslawsky (M.S. Thesis-San Jose State Coll.) Feb. 1965 95 p refs
(Contract W-7405-ENG-48)
(UCRL-7186-T, Rev. 1) CFSTI: $3.00

Mathematical methods for solving plane stress problems in elasticity are described. One of these methods is then applied to obtain the solution of the plane stress problem for a rotating octagonal disk. Relationship between the normal stresses and shear stresses, and the complex potentials is derived. A stress analysis was performed for the the octagonal rotor, and the optimum material, the critical speed, and the deflections at the periphery were determined. E.E.B.

N65-19675# Space Technology Labs., Inc., Redondo Beach, Calif. Systems Design Dept.
UNMANNED SPACECRAFT WEIGHT ESTIMATION HANDBOOK
Donald R. Pence, ed. Dec. 1964 98 p refs

This handbook contains equations, graphs, and procedures to estimate the gross weight of an unmanned spacecraft in orbits out to 250 000 n.mi., with a lifetime up to 1 year. Estimated accuracy is within ±20%. All weight scaling data were obtained from analysis of existing spacecraft and propulsion stages based on these assumptions: (1) Weight, volume, and power data for the gross payload items came from sources outside the handbook. (2) The main attitude control velocity requirements, specific impulses, and thrust are known. (3) The propellants, tankage, pressurization, and piumbing for main or attitude propulsion are contained within the spacecraft's structure. An outline of the options for a number of subsystem configurations is shown. G.G.

N65-19733# Hexcel Products, Inc., Berkeley, Calif.
DEVELOPMENT AND EVALUATION OF A LIGHTWEIGHT ALUMINUM HONEYCOMB CASE Monthly Progress Report, Jun. 1964
E. C. Vicars 6 Aug. 1964 17 p
(Contract DA-04-200-AMC-477(A))
(MPR-6; AD-609867)

Design modifications are summarized. Vibrational and drop tests are evaluated. The hydrostatic pressure tests were not conducted because the joint seal between the end plate and the cylinder was destroyed during the drop test. E.E.B.

N65-19748# Boeing Co., Renton, Wash. Airplane Div.
STRENGTH MARGINS FOR COMBINED RANDOM STRESSES
J. R. Fuller 12 Oct. 1964 26 p refs
(D6-2561TN)

Statistical mechanics procedures are widely used in the aerospace industry to analyze the effects of random loading on flight vehicles. However, while existing procedures give the structures analyst real insight into the loads to which various parts of the vehicle are subjected, they do not provide the stress analyst with a usable procedure for evaluating the structural strength of an element for combined random stresses. The procedure derived permits a determination of the number of times per unit time that various strength margin levels are exceeded for combined random stresses. Author

N65-19774*# Stainless Steel Products, Inc., Burbank, Calif. Engineering Dept.
BELLOWS TUNNEL FUEL TANK Summary Report
Ray Collier 19 Dec. 1964 5 p
(Contract NAS8-5297)
(NASA-CR-57353; Rept.-2313) CFSTI: HC $1.00/MF $0.50

Findings made during the performance of qualification and acceptance testing, and the remedial measures taken, are reviewed. Design analysis of buckling from external pressure showed that the bellows design conformed with all the requirements contained in the specifications. Calculations were verified by testing. E.E.B.

N65-19790 Bell Aerosystems Co., Buffalo, N. Y.
DERIVATION OF THE FORCE-DISPLACEMENT PROPERTIES OF TRIANGULAR AND QUADRILATERAL ORTHOTROPIC PLATES IN PLANE STRESS AND BENDING
R. H. Gallagher and R. D. Huff Jan. 1964 82 p refs
(Contract AF 33(657)-8936)
(D2114-950005; AD-458722)

Detailed derivations are presented for the force-displacement properties of orthotropic triangular and quadrilateral thin plates in plane stress and bending. Included in these relationships are the terms for thermal stress, inelastic, and instability analyses. All derivations are accomplished with the use of a matrix formulation of Castigliano's theorem. Author

N65-19792# Atomics International, Canoga Park, Calif.
ALUMINUM-STEEL RADIATOR CONDENSER (R/C-10) TEST PROGRAM Status Report
W. P. Engle 30 Apr. 1964 42 p refs
(NAA-SR-TDR-9866)

The R/C-10 structure has been subjected to three basic test series: (1) low level vibration; (2) thermal performance with mercury vapor; and (3) a two-phase static structural test, with (a) aerodynamic pressure distribution in combination with 100-percent limit loads, and (b) aerodynamic temperature application in combination with end-boost condition loads. Although data are still being analyzed, the basic feasibility of the aluminum-steel R/C concept has been proven. Areas of design modification for future aluminum-steel radiator condensers have been disclosed, and recorded data have permitted analysis verification as well as performance evaluation. Author

N65-19847*# Little (Arthur D.), Inc., Cambridge, Mass.
DESIGN AND OPTIMIZATION OF SPACE THERMAL PROTECTION FOR CRYOGENS—ANALYTIC TECHNIQUES AND RESULTS Topical Report
Jacques M. Bonneville 18 Dec. 1964 171 p
(Contract NAS3-4181)
(NASA-CR-54190; ADL-65958-02-01) CFSTI: HC $5.00/MF $1.00

The results of analyses and relevant experiments dealing with multilayer insulation, performed during the last four years, are presented in a logical sequence. Emphasis is placed on the experimental fact that in a carefully designed and applied insulation system, the foils will act as intended, i.e., as pure radiative shields. Several relationships useful for determining the heat flow to a cryogenic tank are developed on that basis. Penetrations through the insulation are discussed in detail. Methods for ascertaining their effect, and for decoupling them from the edges of foils, are presented, along with criteria to determine the usefulness of decoupling in a given case. Author

N65-19848*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
COMMENTS ON THE SOLUTION OF THE SPALL-FRACTURE PROBLEM IN THE APPROXIMATION OF LINEAR ELASTICITY
William J. Rae Jan. 1965 67 p refs
(Contract NAS3-2536)
(NASA-CR-54250; CAL-AI-1821-A-3) CFSTI: HC $3.00/MF $0.75

A study is presented of the tensile stresses produced when a compressive spherical wave is reflected from a plane, stress-free surface. Two classes of exact solution of the problem, within the approximation of linear elasticity, are reviewed. In one class, the incident stress distribution is spherically symmetric, while in the other it is only axisymmetric, allowing a variation in one angular coordinate. A significant difference exists between the two classes in the laws relating the strength of incident and reflected waves. The implications of this difference on the reflection of impact-generated stress waves are discussed. The exact solution for cases where the incident wave exhibits spherical symmetry is examined in detail, and simple quadrature formulas for obtaining the reflected stress profile for a given incident waveform are presented. These results are compared with the commonly used solution which considers only the stresses due to a source and its image. The conditions under which this further approximation is acceptable are discussed. The limitations of a linear elastic model in predicting spall fracture are pointed out, and the areas most in need of further study are indicated. Author

N65-19866*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
EXPERIMENTAL DATA ON WIND-INDUCED VIBRATIONS OF A PARABOLOIDAL REFLECTOR ANTENNA MODEL
Norman L. Fox Jan. 1963 22 p refs
(NASA-CR-57422; JPL-CP-5) CFSTI: HC $1.00/MF $0.50

The steady-wind induced oscillations of a series of simplified models of a paraboloidal reflector antenna, located adjacent to a ground plane, were recorded. The models, designed primarily for steady-state wind load measurement, consisted essentially of a single lumped-parameter system. The data are in the form of oscillograph recordings of the three moments in the support staff, at approximately the the ground-plane level, and were obtained over the range of reflector azimuth and elevation angles for several reflector-surface geometries. This memorandum presents samples of the data and the descriptions and calibrations necessary for further analysis. Author

N65-19901*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF STRAIN INDICATOR COATINGS FOR APPLICATION IN DETECTING VOIDS IN BONDED HONEYCOMB SANDWICH STRUCTURES
Paul H. Schuerer and William G. Simpson 21 Sep. 1964 24 p
Supersedes NASA-TM-X-53135; see N65-12335
(NASA-TM-X-53135.1; NASA-TM-X-53135) CFSTI: HC $1.00/MF $0.50

A new concept for manufacturing process control of honeycomb sandwich structures has been successfully demonstrated. Two strain indicator coatings, a brittle lacquer, and a photoelastic plastic were evaluated and proved adequate for detecting unbonded areas in bonded honeycomb sandwich panels. The ease with which the coatings can be applied indicates the potential usage of this void detection technique for larger, more complex surfaces. Author

N65-19915*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VIBRATIONAL CHARACTERISTICS OF SOME THIN-WALLED CYLINDRICAL AND CONICAL FRUSTUM SHELLS
Jerry D. Watkins and Robert R. Clary Washington, NASA, Mar. 1965 31 p refs
(NASA-TN-D-2729) CFSTI: HC $2.00/MF $0.50

Results of an experimental investigation of the vibrational characteristics of thin-walled, circular, cylindrical, and conical frustum shells with free–free and fixed–free boundary conditions are presented and compared with results obtained by using various analytical methods. The shells studied included two right circular cylinders differing in both length and diameter and a series of four conical frustums differing in cone angle but having a constant ratio of length to smaller radius. Experimental results show that free–free conical frustums have higher shell modes wherein a greater number of circumferential waves occur at the larger diameter than at the smaller diameter. The frustums having the greater conicity exhibit the greater differences in number of waves. The data obtained indicate good agreement between experimental and theoretical natural frequencies and mode shapes for cylinders with both free–free and fixed–free boundary conditions and for conical frustums with fixed–free ends. Author

N65-19974# Litton Systems, Inc., St. Paul, Minn. Applied Science Div.
DETERMINATION OF THE SHAPE OF A FREE BALLOON: BALLOONS WITH SUPERPRESSURE, SUBPRESSURE AND CIRCUMFERENTIAL STRESS; AND CAPPED BALLOONS Scientific Report No. 3
Justin H. Smalley 22 Apr. 1964 40 p refs *Its* Rept.-2560
(Contract AF 19(628)-2783)
(AFCRL-65-72; AD-611825)

This report continues the presentation of results of the computation of the shape of an axisymmetric free balloon. Flat-top balloons with superpressure, with subpressure, and balloons with circumferential stress are considered. Circumferential stress is both held constant and varied as a function of meridional stress. Certain limitations on circumferential stress are noted. Shapes, meridional stresses, and circumferential stresses are presented. In addition, similar results are presented for capped balloons with a double-weight cap covering the upper half of the balloon. Author

N65-19977# Polytechnic Inst. of Brooklyn, Freeport, N. Y. Dept. of Aerospace Engineering and Applied Mechanics
STRESSES AND DISPLACEMENTS IN NONCIRCULAR RINGS UNDER ARBITRARY CIRCUMFERENTIAL LOAD

Frank Romano and David Ranlet Jul. 1964 57 p refs
(Contract Nonr-839(14))
(PIBAL-676; AD-603496)

Exact, closed-form solutions are presented for a doubly symmetric, noncircular, deep ring subjected to a doubly symmetric but otherwise arbitrary distributed circumferential load. Ring geometry is specified by the major–minor axis ratio b/a and the rigidity or thickness parameter $k^2 = I/Ar_0^2$, where I is the principal centroidal moment of inertia, A the cross-sectional area of the ring, and r_0 the average radius of curvature of the noncircular ring center line. The distance of application of the loading from the ring center line z_1 is determined by the parameter e. Calculations of displacements and bending moments were carried out for major–minor axis ratios b/a = 1.00, 1.10, 1.30, 1.50, rigidity parameter k^2 = 0.001, and circumferential loading applied above, on, and below the ring center line. Radial displacement for each harmonic of loading and the total circumferential displacement are effectively independent of the cross-sectional area of the ring A but are dependent on the moment of inertia I, while the bending moments are effectively independent of all cross-sectional properties. Moreover, the effect of applying the load off the center line of the ring is shown to be significant. Author

N65-19997# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
DILATION CONSTANTS AND COMPLEX RATIO FROM FORCED VIBRATION OF A FREE VISCOELASTIC SPHERE
T. M. Lee Jan. 1965 13 p refs
(CRREL-RR-147; AD-611751)

The technique of forced vibration was applied to the study of the properties of viscoelastic materials. It is found, through the analysis of a free sphere with a harmonic oscillating internal source, that the vibration amplitude ratio of two measuring points is associated with the complex dilatational constants and the complex ratio of the materials, a quantity directly related to the complex Poisson ratio. Therefore, from the criterion of maximum amplitude ratio (i.e., by adjusting the frequency of the source until the amplitude ratio reaches maximum), these properties can be expressed in terms of the amplitude ratios and their frequencies. For the convenience of laboratory testing, two particular amplitude ratios, in conjunction with their frequencies, have been employed for this purpose. Simple expressions are given, relating the properties of the test material to quantities measurable in the laboratory, namely the maximum amplitude ratios and their corresponding frequencies. Author

N65-20045# Naval Air Engineering Center, Philadelphia, Pa. Aeronautical Structures Lab.
DETERMINATION OF FATIGUE CHARACTERISTICS OF A TYPICAL NOSE LANDING GEAR
M. S. Rosenfeld and R. J. Zoudlik 21 Dec. 1964 40 p refs
(NAEC-ASL-1079; AD-609907)

Twenty identical, unused nose landing gears were tested to determine their structural fatigue characteristics. Twelve specimens were tested under constant-amplitude loading and eight under spectrum loading. The constant-amplitude tests were cycled between a lower load level of zero and various upper load levels including a maximum value of 140% limit load. The spectrum tests were performed for three different spectra; for each the load was cycled from a lower load level of zero to the various upper load levels associated with it. Preliminary results indicate that use of the Miner–Palmgren hypothesis results in conservative estimates of life compared to actual values obtained from spectrum tests at $R > 0$ and results in unconservative estimates when compared to actual values obtained from spectrum tests at $R < 0$. Author

N65-20048# Stanford Research Inst., Menlo Park, Calif. Poulter Research Labs.
DYNAMIC BUCKLING OF A THIN CYLINDRICAL SHELL UNDER AXIAL IMPACT
H. E. Lindberg and R. E. Herbert 2 Feb. 1965 30 p refs
(Contract AF 29(601)-6360)
(TR-001-65; AD-612680)

Buckling of thin cylindrical shells from axial impact is studied under the assumption that initial imperfections can be approximated by "white noise." Linear small deflection theory is used to calculate the resulting growth of the normal modes and a statistical analysis gives the expected values for the "preferred" axial and circumferential wavelengths. Very-high-speed photographs (240 000 frames/sec) of shells buckling under axial impact show excellent agreement with the theory and demonstrate that large deflection buckling follows the pattern established by the early linear motion. Author

N65-20086# Defence Research Board, Ottawa (Ontario). Directorate of Scientific Information Services
EXPERIMENTAL DATA AND SUGGESTIONS FOR IMPACT TESTING
W. Spath Jul. 1964 11 p refs Transl. into ENGLISH from Radex-Rudschau (Austria), no. 7, 1956 p 327–333
(T-113-G)

The simultaneous measurement of impact energy and maximum load with a new impact testing machine makes it possible to achieve a superior specification of the test results. It is possible to construct model impact diagrams with the same area and maximum load as the real impact diagram and, subsequently, to compute the deformation. The advantages to be gained are shown by numerous examinations of different plastics. There were eight individual bars of each category available, from which the average values and the deviations were computed according to the standard deviation. From these considerations, some hints are obtained as to the interpretation of not yet clarified questions arising from impact tests of that kind. The function of the impact tenacity on the test-bar measurements is emphasized. It is suggested to relate the measured impact energy not to the cross section of the test bar, but to the moment of resistance of the test bar. The dimensions of the impact toughness obtained in this way are therefore cm.kg./cu.cm. Some preliminary remarks on the clarification of further functions of the impact energy on the existing testing conditions are made, taking into consideration the dynamic vibrations. The new impact-testing machine is also being used on abrasives, natural and artificial coal, sintered hard metals, and hardened steels. Author

N65-20091# Technisch Documentatie en Informatie Centrum voor de Krijgsmacht, The Hague (Netherlands). Advies Bureau der Genie
COMPUTATION OF REINFORCED CONCRETE CONSTRUCTIONS RESISTING EXPLOSION LOADS [BEREKENING VAN GEWAPEND BETONCONSTRUCTIES TEGEN EXPLOSIEBELASTINGEN]
J. Th. Slot Sept. 1963 74 p refs In DUTCH *Its* Rept.-54
(TDCK-39919)

The problem of blast protection for reinforced concrete buildings is considered. The report is divided into three parts: (1) the behavior of concrete and steel under blast loads; (2) concrete computation by crack-propagation method; and (3) determination of the applicable design moments for construction. E.P.V.

N65-20115*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FATIGUE: A COMPLEX SUBJECT—SOME SIMPLE APPROXIMATIONS
S. S. Manson Washington, NASA, 1965, 107 p refs Presented to Soc. for Exptl. Stress Analysis, Cleveland, 30 Oct. 1964
(NASA-TM-X-52084) CFSTI: HC $4.00/MF $0.75

Strain cycling—the repeated alternation of positive and negative loads to maintain constant strain—is analyzed in detail as a method studying fatigue in materials. Fatigue life, strain hardening and softening, effect of yield stress and notch sensitivity on fatigue life, universal slope for plastic strain line, crack propagation and the power law for cyclic life, are all considered in the framework of strain cycling. Also presented are descriptions of various photoelastic, X-ray, electron microscope, and etching and decoration methods of studying fatigue.
J.M.D.

N65-20117# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TO DETERMINE NATURAL OSCILLATION FREQUENCIES OF A CYLINDRICAL SHELL, FASTENED BY VARI-DISTANT RIGIDITY RIBS
M. I. Karpov 20 Jan. 1965 15 p refs Transl. into ENGLISH from Prikl. Mekhan. (Ukraine), v. 10, no. 1, 1964 p 32–39
(FTD-TT-64-796/1; AD-610766)

Described is a method of solving the problem of oscillations of a shell fastened by stringers as a contact problem of the theory of shells and rods. The obtained partial equation, has the form of a determinant of k-order, where k is the number of stringers. It is suitable for qualitative investigation of the frequency spectrum of the fastened shell, and for numerical calculations as well.
Author

N65-20118# Stevens Inst. of Tech., Hoboken, N. J.
INVESTIGATION OF BENDING MOMENTS WITHIN THE MIDSHIP HALF LENGTH OF A MARINER MODEL IN EXTREME WAVES First Progress Report
Naresh M. Maniar Washington, NAS-NRC, Jun. 1964 27 p refs Prepared for Ship Struct. Comm.
(Contract NObs-88263)
(SSC-163; AD-605396)

One objective of this project was to obtain experimental model data to describe the lengthwise vertical wave bending-moment distribution within the midship half-length of a normally loaded Mariner-type cargo ship in regular head and following waves having wave-height/wave-length ratios between 0.05 and 0.11; a second loading condition was also examined. Another objective was to determine whether the moments tend to reach an upper limit as wave height increases. A 1/96-scale model was cut to form six segments which were jointed by an aluminum beam. The beam was strain gaged to measure bending moments at the hull cuts at stations 5, 7 1/2, 10, 12 1/2, and 15. Within practical operational limits for the Mariner-type ship, maximum wave bending moments in high regular waves occur in the region from amidships to 0.125L aft of amidships. Hogging and sagging moment at any section were generally proportional to wave height up to a wave-height/wave-length ratio of 0.11, the steepest wave that could be generated.
Author

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N65-18641# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF GAS MOVEMENT AND HEAT TRANSFER IN ROTATING ROTORS
V. V. Mal'tsev 11 Jun. 1963 20 p refs Transl. into ENGLISH from Vestn. Elektroprom. (Moscow), v. 11, 1962 p 15–22
(FTD-TT-63-366/1+2+4; AD-409305)

Coefficients of heat transfer in radial channels, determined at various rotational speeds and with air movement away from the axis of rotation and toward the axis of rotation, are reported. During laminar flow it was observed that with increase in rotational speed there was a decrease in the heat transfer coefficient in radial channels but an increase for axial channels. It was established: (1) Values of the critical Reynolds numbers depend on the rotational speed of the rotor, gas flows through the gap, and the roughness of the surface of the rotor and stator. (2) The greater the ratio of axial velocity to peripheral velocity, the larger the Reynolds number becomes. (3) Critical Reynolds numbers are given for rotating rotor and fixed rotor, for identically smooth surfaces of rotor and stator and with no axial flow.
E.E.B.

N65-18642# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF AN ELECTRICAL FIELD ON FLAMES
A. Ye. Potapenko and P. P. Kostenko 12 Jun. 1963 9 p refs Transl. into ENGLISH from Inshenerno-Fiz. Zh. (Minsk), v. 5, no. 10 p 73–76
(FTD-TT-63-408/1+2+4; AD-409307)

The possibility of improving the blowoff characteristics of burners by applying a constant electrical field to the flames is discussed. Tests were conducted on a nozzle burner of pyrex glass with an outlet diameter of 9.8 mm. A central electrode was placed inside the burner 26 mm below its rim, and above the burner a metal ring of 32 mm was placed to serve as the second electrode. No essential change in the form of the inside cone and normal flame-propagation velocity with application of the electric field was observed.
E.E.B.

N65-18650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTRIBUTION TO THE METHOD OF INVESTIGATING COMBUSTION CHAMBERS OF AVIA TURBINE ENGINES
Jerzy Grzegorzewski 23 Nov. 1964 14 p refs Transl. into ENGLISH from Tech. Lotnicza (Poland), no. 9, 1963 p 230–233
(FTD-TT-64-105/1+2; AD-453057)

An investigation is reported on the annular evaporation-combustion chamber of an aircraft turbine engine. Preliminary studies of model chambers were conducted in a water tunnel. The instrumentation of the model for bench testing is described, and a recording system for the measured parameters is discussed. The data were processed and formulas for various effects and errors are given.
D.E.W.

N65-18680# Yale Univ., New Haven, Conn. Dept. of Engineering and Applied Science
ON THERMAL CHOKING AND CONDENSATION IN NOZZLES
Andrew A. Pouring Jan. 1965 32 p refs
(Contract Nonr-609(47))
(Rept.-4; AD-610642)

An experimental and analytic analysis of water vapor condensation zones in moist air expansions is considered where the heat addition of condensation exceeds that for thermal choking. The transition from an unchoked to a choked flow is shown experimentally and described from the viewpoint of an analogous isentropic nozzle. Solution of the one-dimensional equations of motion for a fully choked nozzle flow involving shock waves is given and sonic point locations are verified experimentally. Special emphasis is given to the effect of heat addition and area variation on flow behavior in the region of sonic points. Some other related experimental findings on condensation are also reported. Author

N65-18694# General Motors Corp., Santa Barbara, Calif. Aerospace Operations Dept.
THE MICROWAVE ABSORPTION AND DISPERSION OF HEATED AIR
I. P. French Jan. 1965 31 p refs
(Contract DA-01-021-AMC-11359(Z); ARPA Order 347; Proj. Defender)
(TR65-OIC; AD-458151)

The absorption and dispersion of room temperature air at microwave frequencies were discussed in a previous report, the present report extends the discussion to high-temperature air, by using the Van Vleck–Weisskopf theory. The behavior of the complex dielectric coefficient of heated air at frequencies in the region of 52 to 68 Gc (due to molecular oxygen) and 150 to 151 Gc (due to nitric oxide) is considered. In general, absorption is less at higher temperatures. Author

N65-18867# Naval Ordnance Lab., White Oak, Md. Air-Ground Explosions Div.
THE FLOW FIELD BEHIND A SPHERICAL DETONATION IN TNT USING THE LANDAU-STANYUKOVICH EQUATION OF STATE FOR DETONATION PRODUCTS
M. Lutzky Feb. 1965 29 p refs
(NOLTR-64-40; AD-610335)

Calculations were made of the flow field in the isentropic region behind a detonation wave in TNT, using the Landau–Stanyukovich equation of state for the detonation products. Adjustable constants in this equation were evaluated by imposing ideal gas behavior on the detonation products in the large expansion (low density) limit, and by fitting to an experimental curve of detonation velocity versus loading density. Calculated values of Chapman–Jouguet variables correspond fairly well with experimental values at various loading densities, with the exception of the temperatures, which seem far too low. This is connected to the fact that the theory predicts an upper limit to the loading density at which an explosive will detonate; at this point the thermal energy vanishes and only the elastic energy contributes to the energy of detonation. Author

N65-18870# Purdue Univ., Lafayette, Ind. Jet Propulsion Center
PROPAGATION OF WEAK DISCONTINUITIES IN ROCKET MOTOR COMBUSTION CHAMBERS. PART I
G. M. Lehmann and S. N. B. Murthy Dec. 1964 96 p refs
(Contract Nonr-1100(21))
(JPC-395; TM-64-8; AD-610383)

An important feature of the nonlinear (or nonacoustic) theories of combustion pressure oscillations in rocket motors is the occurrence of weak shock-like discontinuities. The magnitude of such a discontinuity changes as it propagates in the motor, due to its interaction with the different processes and gradients in flow properties occurring in the combustion chamber. This report presents an analysis of the interaction of the discontinuity with those processes and gradients, as well as a method for computing the instantaneous magnitude of the weak shock-like discontinuity at different sections of a combustion chamber. While the method developed here is general enough for adaptation to any chemical rocket system, the particular case chosen for explaining the details of the method is related to a rocket motor equipped with an end-burning solid-propellant grain. Author

N65-18891*# National Aeronautics and Space Administration, Washington, D. C.
HOT AIR IN SPACE TECHNOLOGY
Alfred Gessow [1965] 36 p Presented at 52nd Ann. Meeting of the Compressed Gas Assoc., New York, 18 Jan. 1965 Available from the Scientific and Technical Information Division

Problems involving the heat transfer and velocities of reentry and those expected to be encountered in entry into other planetary atmospheres, with emphasis on Mars and Venus, were covered by Alfred Gessow, NASA. The difficulty of simulating in the laboratory all of the flight conditions that a spacecraft would encounter in reentry and space flight is reviewed. Propulsion problems and the advanced propulsion concept—the coaxial-gaseous flow nuclear rocket—is then discussed. His last topic dealt with the plasma state of matter. In conclusion, the point was made that the researcher is ever hopeful that his efforts will bear fruit, but he must be prepared for occasional disappointments and perhaps more importantly, he must accept the fact that even when he is successful, he usually can never tell just when and how his work will be used. E.E.B.

N65-18893*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
PRELIMINARY STUDY OF AIR AUGMENTATION OF ROCKET THRUST
R. L. Perini, R. E. Walker, and G. L. Dugger Jan. 1964 29 p refs
(Contract NOw-62-0604-c)
(TG-545; AD-451695)

Assumptions, the method of analysis, and results of a parametric study of thrust augmentation of a fuel-rich rocket by air injection and supersonic afterburning are described. The analysis indicated that significant gains in I_{sp} should be possible. For the 45% aluminum propellant, a chamber pressure of 1000 psia, and the Mach 3, 40 000-ft flight conditions assumed, the following effects are indicated: The air injection static pressure should be near 50 psia, if possible, but need not be much greater to get near-optimum performance. High diffuser kinetic energy efficiency is important, but not critical. Complete mixing is desirable but not crucial. Weak oblique shocks in the rocket gas due to the air injection will significantly affect the I_{sp} achieved. D.E.W.

N65-18925# Purdue Univ., Lafayette, Ind. Jet Propulsion Center
STUDIES IN HYBRID COMBUSTION Final Report
R. J. Zabelka and D. F. Brink Jan. 1964 245 p refs
(Contract N123(60530)29155A)
(JPC-362; F-64-1)

The fuels tested included a gel of liquid hydrazine suspended in a hydrocarbon binder, the gel plus a small addition of a cross-linking agent, the cross-linked gel with aluminum powder added, and Plexiglas. Three-dimensional combustion bombs were used for small fuel samples, and two-dimensional slab burners were used for larger ones. Since the oxidizer, gaseous oxygen, impinged normal to the surface of the bomb samples and flowed axially across the slab surfaces, combustion in laminar or turbulent boundary layers above the burning surfaces could be studied. The burning rate of the fuel was considered a primary dependent variable. Fuel composition, oxidizer mass flux in the vicinity of the fuel surface, chamber pressure, chamber geometry, and injector design were used as independent variables and were studied for their influence on burning rate. Other influences considered were flame position with respect to fuel surface, heat transfer from flame to fuel, and chemical kinetics of gas–surface interactions. The prime influences were fuel composition and heat transfer. E.P.V.

N65-18947*# Electro-Optical Systems, Inc., Pasadena, Calif.
CONDENSER HEAT REJECTION SYSTEMS Monthly Progress Report, 28 Jan.–24 Feb. 1962
Lance Hays 10 Mar. 1962 3 p
(Contract NAS7-11)
(NASA-CR-57175; EOS-1588-ML-16) CFSTI: HC $1.00/MF $0.50

Investigations of large-diameter jet condensers were continued. Analysis of the data obtained for the initial test unit and testing of a similar geometry without the constant area throat were conducted. Large-diameter jet condenser testing will be resumed after completion of a current series of calibrations of flow, temperature, and pressure instrumentation. The flow distribution characteristics of the multitube jet condenser vapor header were investigated with air. The maximum measured deviation (6%) of individual tube flow rates from the mean flow rate was approximately equal to the maximum uncertainty associated with the measuring apparatus. Author

N65-18987# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.
CONTINUED STUDIES ON ELECTROMAGNETIC MEANS OF ADDING HEAT AND KINETIC ENERGY TO A GAS
Eugene E. Covert, Laurence R. Boedeker, and Charles W. Haldeman Wright-Patterson AFB, Ohio, ARL, Dec. 1964, 138 p refs
(Contract AF 33(657)-7975)
(ARL-64-211; AD-610821)

The work on electromagnetic means of adding heat and kinetic energy to a flowing gas stream is described. Included are discussions of the nonequilibrium rf plasma source; design considerations for accelerator coils for the traveling wave pump plasma accelerator; the effects of using magnetic core material in the accelerator coils; numerical results for the one-dimensional flow in the traveling wave pump for various modes of operation; and methods of instrumentation employed to measure plasma properties with the primary difficulties encountered. Author

N65-19055# Rocket Propulsion Establishment, Westcott (England).
CORRECTIONS INVOLVED IN ASSESSING THE PERFORMANCE OF LIQUID OR GASEOUS PROPELLANT ROCKET ENGINE THRUST CHAMBERS
C. Ramshaw Aug. 1964 20 p refs
(RPE-TM-326; AD-454601)

This memorandum outlines some of the more important corrections which should be applied when the performance of a liquid propellent rocket engine thrust chamber is studied. To determine truly significant performance efficiencies it is necessary to amend the theoretical performance data of a rocket engine to take account of the deviations from ideality of the engine. It is suggested that this be effected by evaluating a thermal advantage for the particular engine, as compared with the corresponding ideal engine and determining the appropriate correction factor, and by taking account of the coefficient of discharge, which if less than unity reduces the effective value of the characteristic velocity. Fundamental combustion loss has little effect on the vacuum exhaust velocity at high pressure ratios, and none if the nozzle terminates at the throat, and the flow remains choked. Author

N65-19093# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.
INITIATION OF EXPLOSIVES BY EXPLODING WIRES. PART V: EFFECT OF WIRE MATERIAL ON THE INITIATION OF PETN BY EXPLODING WIRES
Howard S. Leopold 10 Dec. 1964 49 p
(NOLTR-64-146; AD-609449)

Aluminum, gold, platinum, and tungsten wires were investigated to determine the effect of the wire material on the initiation of PETN by exploding wires. The wires were exploded by a one microfarad capacitor charged to 2000 V. The results indicate that favorable wire materials are those into which energy is deposited at a rapid rate. They also have low boiling points and heats of vaporization. Heat of oxidation of the wire material plays only a minor role. Different wire materials have different optimum lengths for effecting detonation. Author

N65-19163# Army Electronics Labs., Fort Monmouth, N. J. Engineering Design Div.
CURRENT STATUS AND FUTURE TRENDS OF CRYOGENIC COOLERS FOR ELECTRONIC APPLICATIONS
Charles A. Stochl and Edward R. Nolan Jul. 1964 57 p refs
(ECOM-2524; AD-610015)

This report discusses the technical aspects of cryorefrigeration, the availability of hardware, and trends in cryocooler developments. Included is a list of recommended programs designed to upgrade present cryocooler equipment. Author

N65-19179# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILIZATION OF A FLAME AND THE DEVELOPMENT OF THE COMBUSTION PROCESS IN TURBULENT FLOW Selected Parts
G. M. Gorbunov et al 12 Apr. 1963 143 p Transl. into ENGLISH from the book "Stabilizatsiya Plameni i Razvitiye Protessa Sgoraniya v Turbulentnom Potoke" Moscow, Oborongiz, 1961 p 31–148
(FTD-TT-62-768/1+2; AD-402800)

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2. INVESTIGATION OF PROPAGATION AND STABILIZATION OF A FLAME BEHIND A TROUGH-SHAPED STABILIZER E. L. Solokhin p 24–51 (See N65-19181 09-33)

3. INFLUENCE OF THE TURBULENCE PARAMETERS ON THE COMBUSTION OF A HOMOGENEOUS GASOLINE-AIR MIXTURE BEHIND A STABILIZER UNDER CONDITIONS OF A CLOSED STREAM V. P. Solntsev p 52–92a (See N65-19182 09-33)

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5. ON THE DESIGN OF THE SIMPLEST COMBUSTION CHAMBER OF THE RAMJET TYPE K. P. Vlasov p 116–140 (See N65-19184 09-33)

N65-19180 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF TURBULENCE PARAMETERS ON THE VELOCITY OF FLAME PROPAGATION

G. M. Gorbunov *In its* Stabilization of a Flame and the Develop. of the Combust. Process in Turbulent Flow 12 Apr. 1963 p 1–23 (See N65-19179 09-33)

Velocity of flame propagation in the turbulent wake of a jet nozzle was studied experimentally. Velocity measurements were made behind a large nozzle, with various turbulizing grids, and again in absence of grids. It was concluded that the turbulent combustion velocity is an approximately linear function of the pulsating frequency component of the turbulent stream behind the nozzle. J.M.D.

N65-19181 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF PROPAGATION AND STABILIZATION OF A FLAME BEHIND A TROUGH-SHAPED STABILIZER

E. L. Solokhin *In its* Stabilization of a Flame and the Develop. of the Combust. Process in Turbulent Flow 12 Apr. 1963 p 24–51 (See N65-19179 09-33)

Stabilization of the flame behind a jet nozzle was studied experimentally. In particular, the effects of various stabilizers were tested behind the nozzle of a jet. Conclusions drawn from test data were these: (1) The backflow zone behind a trough-like stabilizer increases during combustion as incoming-stream velocity and stabilizer dimensions are increased. (2) Turbulence-exchange coefficient increases near the boundary of the circulation zone and the active stream. (3) Flameout characteristics improve with increasing stabilizer dimensions. J.M.D.

N65-19182 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INFLUENCE OF THE TURBULENCE PARAMETERS ON THE COMBUSTION OF A HOMOGENEOUS GASOLINE-AIR MIXTURE BEHIND A STABILIZER UNDER CONDITIONS OF A CLOSED STREAM

V. P. Solntsev *In its* Stabilization of a Flame and the Develop. of the Combust. Process in Turbulent Flow 12 Apr. 1963 p 52–92a (See N65-19179 09-33)

Combustion flame front behind various jet-engine stabilizers was studied in a combustion chamber. The chamber design included jet engine, turbulizing grid, measuring baffle, and several stabilizers. Test data indicate that (1) position of the flame front is independent of the incoming-stream velocity; (2) propagation rate of the turbulent flame front is proportional to the pulsational component of velocity, and independent of the average frequency of the turbulent pulsations; and (3) spreading of the flame front results when aperture angle of the stabilizer is increased. J.M.D.

N65-19183 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

COMBUSTION OF GASOLINE-AIR MIXTURE BEHIND STABILIZER SYSTEMS

V. P. Solntsev and V. A. Golubev *In its* Stabilization of a Flame and the Develop. of the Combust. Process in Turbulent Flow 12 Apr. 1963 p 93–115 (See N65-19179 09-33)

Interaction of the turbulent trails of various jet-engine stabilizers was studied in a combustion chamber. The stabilizers were mounted singly, and again in combinations, in a series of firings. An interaction was observed between the turbulent trails of two stabilizers, where one stabilizer trail had larger turbulence scale and intensity and led to an increase in these parameters in the second stabilizer trail. J.M.D.

N65-19184 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ON THE DESIGN OF THE SIMPLEST COMBUSTION CHAMBER OF THE RAMJET TYPE

K. P. Vlasov *In its* Stabilization of a Flame and the Develop. of the Combust. Process in Turbulent Flow 12 Apr. 1963 p 116–140 (See N65-19179 09-33)

A method was proposed for the design calculations of a very simple ramjet combustion chamber, consisting of closing the fundamental gas dynamic equations for the flow of a combustible mixture in a cylindrical tube with a pointlike ignition source, by introducing a supplementary condition whereby the width of the combustion zone depends on the distance to the ignition source. The results of the calculation were compared with some experimental data. Good agreement between calculation and experiment was demonstrated. Author

N65-19195# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE MECHANISM OF HEAT TRANSFER IN THE BOUNDARY LAYER DURING A CHANGE IN THE PHYSICAL PROPERTIES OF FLUIDS

A. Slanciauskas, J. Ziugzda, and A. Zukauskas 23 Nov. 1964 6 p Transl. into ENGLISH from Mokslas Ir Tech. (Kaunas), no. 4, 1963 p 34–35
(FTD-TT-64-358/1+2+3+4; AD-453064)

A method for the evaluation of heat transfer in bodies when, after a temperature change, the physical properties of the fluid undergo considerable change, is presented. E.E.B.

N65-19220# Army Cold Regions Research and Engineering Lab., N. H.

HEAT TRANSFER CHARACTERISTICS OF VENTILATED SNOW

Yin-chao Yen Jan. 1965 21 p ref
(CRREL-RR-106; AD-611019)

For determining the heat transfer due to vapor transfer in snow with air flowing through it, the experimental technique consists of the determination of the effective diffusivity D_e of water vapor through snow, which is subsequently used to calculate the contribution of heat transfer through the mechanism of vapor diffusion. The results are interpreted as k_v, equivalent thermal conductivity of snow due to vapor transfer, and can be well represented by the following expression, for airflow rates G ranging from about 2 to 40 $\times 10^{-4}$ g/cm^2-sec:

$$k_v = 0.77 \times 10^{-4} + 0.314\,G - 89.40\,G^2 + 8640\,G^3$$

where k_v is in cal/cm-C-sec. When there is no airflow through snow, k_v contributes about 7.5% of the total value of k_e, effective thermal conductivity of snow. However, for airflow

rate of 10×10^{-4} g/cm^2-sec or for a pore velocity of about 1.3 cm/sec. k_v is about 19% of the value of k_e. Therefore, the vapor transfer makes a significant contribution to the processes of heat transfer associated with a natural snow cover. Author

N65-19222# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
NONEQUILIBRIUM EXPANSIONS OF HIGH-ENTHALPY AIRFLOWS Interim Technical Report
J. A. Lordi and R. E. Mates Wright-Patterson AFB, Ohio, ARL, Nov. 1964 64 p refs
(Contract AF 33(657)-8860)
(ARL-64-206; AD-610820)

Numerical solutions for nonequilibrium expansions of air from high stagnation temperatures and pressures were obtained ($8000° K \leq T_0 \leq 15\,000° K$, $10 \leq \rho_0/\rho_{S.L} \leq 100$). The results of these calculations are pertinent to the description of nonequilibrium effects on flows aimed at simulation of orbital velocity and higher. Refinement of previous computing techniques for nonequilibrium nozzle flows was required to complete the solutions presented. The thermodynamic chemical-kinetic model for air includes the six species established to be the dominant ones. These species are subject to vibrational and electronic excitation and coupled, chemical reactions. At the high densities considered here molecular interactions exert a significant influence on the equation of state. An excluded-volume correction which agrees with more detailed analyses was developed to account for these effects in the air model. The results obtained for nonequilibrium effects in high-enthalpy expanding airflows show them to have significant influence on the thermodynamic properties and composition of the flow. Methods of correlating these nonequilibrium effects for various reservoir conditions were found. Previous results for nonequilibrium expansion of air from lower reservoir temperatures are included in this correlation. Means of suppressing nonequilibrium effects in such flows are discussed in terms of the results obtained. The complete elimination of nozzle nonequilibrium by increasing reservoir pressure or changing nozzle geometry is shown to be quite difficult. Author

N65-19270*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
COMPARISONS OF EXPERIMENTAL AND THEORETICAL AERODYNAMIC HEATING RESULTS IN AIR-CARBON DIOXIDE MIXTURES
E. A. Laumann 15 Jan. 1965 15 p refs
(Contract NAS7-100)
(NASA-CR-57215; JPL-TR-32-715) CFSTI: HC $1.00/MF $0.50

Convective heat-transfer experiments were conducted in a hypersonic wind tunnel in air–carbon dioxide mixtures. The mixtures were in chemical equilibrium, and the amounts of carbon dioxide in air were varied from 0% to 72% by volume. The convective heating of three different model shapes was measured, using calorimetric techniques. The results of these experiments are compared with the stagnation point heating theory of Fay and Riddell, using the Lennard–Jones potential theory to evaluate the transport properties of the gas mixtures. The heat-transfer distributions are compared to the theory of Lees. Author

N65-19284*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
OXYGEN-JET BEHAVIOR DURING COMBUSTION INSTABILITY IN A TWO-DIMENSIONAL COMBUSTOR
Marcus F. Heidmann Washington, NASA, Mar. 1965 14 p Presented at the 5th Liquid Propulsion Symp. of the Chem. Propulsion Inform. Agency, Tampa, Fla., 12–14 Nov. 1963
(NASA-TN-D-2725) CFSTI: HC $1.00/MF $0.50

A burning liquid-oxygen jet was observed photographically during both stable and unstable operation in a gaseous-hydrogen-fueled rocket combustor. The stable jet appeared as a loosely contained mass of liquid, which disintegrated into a maze of interconnected ligaments. Normal drop formation was not observed. During chugging instability, the oxygen flow rate responded to chamber-pressure oscillations and caused large variations in the atomization process. The burning rate appeared to respond to both the degree of atomization and the quantity of liquid within the combustor. Cyclic variations in the magnitude and the position of the primary burning zone were evident. With high-frequency transverse instability, the length of the burning jet decreased from its stable value and responded to the oscillations. No abrupt change in jet characteristics was evident during the cyclic process. Mass removal appeared as a continuous process depending on the gas velocity and the amount of liquid subjected to this velocity. Author

N65-19304# Astrosystems International, Inc., Fairfield, N. J.
MONITORING OF ROCKET ENGINE PERFORMANCE BY SPECTROSCOPIC TECHNIQUES Technical Report, 10 Apr.–10 Aug. 1964
Robert F. Strauss Wright-Patterson AFB, Ohio, AF Flight Dyn. Lab., Oct. 1964 149 p refs
(Contract AF 33(615)-1614)
(AFFDL-TR-64-163; AD-609492)

An analytical investigation studied the emission spectra of the exhaust stream of selected rocket engine liquid propellant combinations to determine the feasibility of detecting exhaust specie spectra as a measure of various propulsion system characteristics. The propellants selected for analysis were oxygen–hydrogen, oxygen–RP-1, and nitrogen tetroxide–unsymmetrical dimethylhydrazine as being most representative. A rocket engine for test was designed having a chamber pressure of 50–100 psia and a flow rate of 0.1 gm/sec. Calculations of signal strength with mixture ratio were made and the species OH, NH, CO and NO found to be of most interest. It was determined that mixture ratio variations and flow rate variations could be separately detected. A system for detecting incipient burnout by monitoring metallic oxide emissions and instability by intensity frequency pattern variations was presented. A flight weight system was shown to be feasible. Author

N65-19380# Aerojet-General Corp., Sacramento, Calif. Propellant Research Div.
INVESTIGATIONS OF THE MECHANISMS OF DECOMPOSITION, COMBUSTION, AND DETONATION OF SOLIDS Twentieth Quarterly Technical Operating Report, 1 Oct.–31 Dec. 1964
L. J. Rosen Jan. 1965 10 p refs
(Contract AF 49(638)-851; ARPA Order 24-60)
(Rept.-0372-01-20Q; AD-610802)

The overall stoichiometry of the NH_3-N_2O counterflow diffusion flame was determined from mass spectrographic analyses of the reaction products. The exothermicity of this flame reaction is governed by the reaction

$$NH_3 + N_2O \longrightarrow 1/2H_2 + 3/2N_2 + H_2O.$$

The volumetric reaction rate ($\dot{M}_{ij,max}$) and heat release rate ($\dot{q}_{max}$) for this reaction are 1.95g/cm^3-sec and 7.6×10^3 cal/cm^3-sec, respectively. Author

N65-19385# Rocketdyne, Canoga Park, Calif.
A STUDY OF HEAT TRANSFER CHARACTERISTICS OF HOT GAS IGNITION Third Quarterly Progress Report, Period Ending 31 Jan. 1965
L. W. Carlson 8 Feb. 1965 25 p
(Contract AF 04(611)-9884)
(RM-1123/362; AD-611282)

A number of heat transfer effects were observed as follows: (1) Developed heat transfer matches Dittus–Boelter-type correlations. (2) Transient heat transfer exists within the test section for a time duration of a large fraction of a second. (3) Heat transfer maxima related to periodic shock phenomena within the test section chamber can occur. (4) Data from shorter L/D tests are reproducibly coincident with the entrance data for longer L/D test sections, except for exist nozzle shock effects which persist in some cases for approximately two diameters back into the test section. (5) The nozzle extension distance, L, within the test section, is not a significant parameter; it merely shifts the entire heat transfer distribution. (6) The exhaust area ratio is a significant parameter in determining the heat transfer level; the effect is related to jet aspiration or pressurization of the test chamber volume. (7) An axial head end supersonic nozzle (optimum expansion) shifts the point of maximum heat transfer downstream to the center of the test section, while maintaining equivalent integrated heat transfer. Greater shock disturbances were noted for the supersonic igniter nozzle at the aft end of the test section than were noted for the sonic igniter nozzle. Author

N65-19405# AVCO Corp., Wilmington, Mass. Research and Advanced Development Div.
LAMINAR AND TURBULENT CONVECTIVE HEATING ON CONICAL BODIES IN PLANETARY ATMOSPHERES
Paul Sones Jan. 1965 38 p refs
(RAD-TM-64-68; AD-454403)

Methods were devised from existing techniques for the prediction of laminar and turbulent convective heat transfer rates on cones in planetary atmospheres. Comparison of these methods with experimental data from nitrogen–carbon dioxide mixtures was made to check their validity when applied to atmospheres other than air. The laminar predictions are obtained from two methods, a similar solution of the boundary layer equations, and a reference enthalpy approach. The reference enthalpy approach is then further adapted for the turbulent flow conditions. The comparison of theory and experiment shows good agreement and indicates that the methods are valid for planetary atmospheres. Author

N65-19431# Kaman Aircraft Corp., Colorado Springs, Colo. Kaman Nuclear Div.
SHOCK FRONT RELATIONS FOR AIR IN THERMODYNAMIC EQUILIBRIUM FOR ALTITUDES FROM SEA LEVEL TO 60 KILOMETERS AND FROM SEA LEVEL TO 230 KILOFEET
Louis E. Bothell and Belmont S. Evans 10 Nov. 1964 103 p refs
(Contract NOsp-64021-c)
(KN-64-326(R); AD-610470)

Extensive computer calculations are presented for various ambient conditions of strong shocks in air which is in chemical equilibrium on each side of shock discontinuities. The equations for the computer program are based on Rankine–Hugoniot relations and are functions of altitude, and the ambient temperature, pressure, density and speed of sound. The altitudes are restricted to the region where air molecular weight is stable and where molecular-scale and kinetic temperatures are equal. Temperatures are below 2000° K. For all altitudes considered the maximum shock strength exceeded 1500, with the maximum values being higher for higher altitudes. With increasing altitude the pressure–density curve becomes more irregular and the maximum density ratio increases. J.M.D.

N65-19494# Parametrics, Inc., Waltham, Mass.
RESEARCH DIRECTED TOWARD INVESTIGATIONS IN SHOCK TUBE LABORATORY ASTROPHYSICS Final Report, Jan. 6–Jan. 5, 1965
Edmund H. Carnevale, Glenn S. Larson, and Stanley J. Wolnik 5 Feb. 1965 58 p refs
(Contract AF 19(628)-3881)
(AFCRL-65-74; AD-612024)

A brief description is given of the shock tube facility and associated measuring equipment. The theory of radiative transfer in a uniform gas is developed with reference to shock tube spectroscopic measurements. Gas temperatures behind reflected shocks were measured simultaneously by a line reversal technique and by an ultrasonic probe method. The average temperatures agree to within 3-1/2%. Measurements of shock gas density were made with an electron beam gas densitometer. A set of preliminary gf values were determined for 10 Cr I spectral lines distributed over 3 multiplets. Author

N65-19533# Massachusetts Inst. of Tech., Cambridge. Gas Turbine Lab.
CONDENSATION OF AMMONIA VAPOR DURING RAPID EXPANSION
Michael Kremmer and Olufemi Okurounmu Jan. 1965 71 p refs
(Contract Nonr-3963(07))
(Rept.-79; AD-611060)

This report presents an experimental study, through pressure distributions, of the homogeneous nucleation and condensation of initially superheated ammonia vapor during its expansion in a low Mach number supersonic nozzle. The results of the experiments are compared with the classical nucleation theory of Becker and Doring or Frenkel–Zeldovich, on the basis of the predicted pressure and temperature at which condensation would occur starting from a given stagnation condition. It is found that ammonia shows far less supersaturation than this theory predicts. The effect of arbitrary corrections to the surface tension showed that a further reduction in surface tension of the drop relative to the flat-film value gives better agreement between measured and predicted pressure distributions. Even better agreement is obtained without a surface tension correction if the nucleation rate is assumed greater by a factor of 10^{17}. This seems to lend some support to the recent theories of Lothe and Pound and Oriani and Sundquist concerning gassification corrections to the free energy of formation of critical droplets. Author

N65-19650# Martin Co., Denver, Colo.
STAGNATION POINT HEAT TRANSFER FOR A NEW BINARY AIR MODEL INCLUDING DISSOCIATION AND IONIZATION
Sherman J. Fenster Aug. 1964 55 p refs
(R-64-8)

Laminar stagnation-point heat transfer in dissociated and ionized air is considered. A simplified binary diffusion model is proposed and incorporated with the frozen thermal conductivity concept. With this model, calculations are made for both frozen and equilibrium boundary layers in air at velocities up to 50 000 ft/sec and altitudes of 250 kilofeet. The results show that approximations of the atom mass fraction can effect

the boundary layer chemistry incorrectly. Equilibrium heat-transfer rates are progressively lower than the frozen rate, assuming fully catalytic wall, through the dissociation as well as the ionization regime. Nitrogen does not adequately represent air either in terms of chemistry or heat transfer. Comparison with experimental results shows agreement with the calculations. Author

N65-19680# Royal Aircraft Establishment, Farnborough (England).

DEVIATION FROM LAMBERT'S LAW IN THE ABSORPTANCE OF METALLIC AND NON-METALLIC SURFACES AND THE EFFECT OF THESE ON THE THERMAL BALANCE OF SATELLITES

E. C. Semple and K. H. Roshier Jan. 1965 14 p refs
(RAE-TM-Space-53)

In most thermal radiation calculations it is assumed that the emittance and absorptance of a surface are constant in all directions. This is not strictly true and the consequences of the discrepancies on the thermal balance of a satellite are discussed. The ratio of the effective absorptance to the normal absorptance is estimated for some typical satellite surface shapes with metallic and nonmetallic finishes. Author

N65-19684*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

CONVECTIVE HEAT TRANSFER IN A CONVERGENT-DIVERGENT NOZZLE

L. H. Back, P. F. Massier, and H. L. Gier 15 Feb. 1965 58 p refs Revision 1
(Contract NAS7-100)
(NASA-CR-57326; JPL-TR-32-415) CFSTI: HC $3.00/MF $0.50

The results of an experimental investigation of convective heat transfer from turbulent boundary layers accelerated under the influence of large pressure gradients in a cooled convergent–divergent conical nozzle are presented. The results include a maximum in the heat-transfer coefficient upstream of the throat, where the mass flow rate per unit area is largest, and a substantial decrease in heat transfer downstream of the point of flow separation, which occurred in the divergent section of the nozzle at the low stagnation pressures. A reduction of about 10% in the heat-transfer coefficient resulted from an increase in the inlet boundary-layer thickness between the minimum and maximum thicknesses investigated. Heat-transfer predictions with which the data were compared either incorporate a prediction of the boundary-layer characteristics or are related to pipe flow. At the higher stagnation pressures, predicted values from a modification of Bartz' turbulent boundary-layer analysis are in fair agreement with the data. Author

N65-19709# Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering

ENTRANCE FLOW AND TRANSITION FROM LAMINAR TO TURBULENT FLOW IN VERTICAL TUBES WITH COMBINED FREE AND FORCED CONVECTION

Willis Thompson Lawrence (Ph.D. Thesis) 5 Feb. 1965 109 p refs
(Grant NSF GP-503)
(DSR-9365)

This investigation deals with entrance flow in vertical tubes. Using a finite difference method, a theoretical solution to this problem was obtained which solves both upflow and downflow problems for the constant heat flux or constant wall temperature case using an IBM 7094 computer. To obtain an accurate solution, the density must be represented by a quadratic function of temperature, and viscosity must be treated as a function of temperature. The velocity profiles continue to develop as the fluid moves downstream. The transition from laminar to turbulent flow was studied. Experimental measurements with uniform heat flux and upflow in a tube demonstrated that the transition process depends on developing velocity profiles. Finally, using the theoretical solution to obtain developing velocity and temperature profiles corresponding to cases for which experimental transition data were available, a tentative transition criterion was obtained. Author

N65-19757*# General Electric Co., Philadelphia, Pa.

SHOCK TUBE INSTRUMENTATION TECHNIQUES FOR STUDY OF HYPERVELOCITY ENTRY PROBLEMS

J. S. Gruszczynski and D. A. Rogers Sep. 1964 49 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950297)
(NASA-CR-57220; R64SD67; AD-451136) CFSTI: HC $2.00/MF $0.50

Techniques for overcoming the problem of very short test times (10μ–30μ) and electrical interference of the partially ionized test gas with the small signal from model heat transfer gages are presented, and methods of evaluating test gas quality are described. The measurement techniques described have been applied to several studies of stagnation point convective heat transfer and radiative properties of high temperature gases. Typical results obtained in the course of these studies are shown, and instrumentation requirements for the extension of aerothermodynamic investigation in the hypervelocity regime are outlined. Author

N65-19777* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion

PARTIAL MOLAR PROPERTIES OF MAGNESIUM BASE BINARY THERMAL ENERGY STORAGE SYSTEMS

Geoffrey Belton and Y. Rao *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965 9 p refs (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The favorable thermal conduction properties of Mg_2Si suggest that increased attention be given to similar intermetallic compounds. In preparation for galvanic cell measurements on the Mg–Si system, the electrolyte chosen ($MgCl_2$–$CaCl_2$) and the overall system were checked by a study of the Mg–Al system in the range 700° to 900° C. A unique feature of the cell is the inclusion of a reversible chlorine electrode for continual checking of the condition of the pure magnesium electrode by means of the expected potential difference between the pure magnesium and chlorine electrodes. Sufficient precision is available so that the potential difference clearly resolves the usually difficult to obtain temperature variation from which the entropy of mixing is calculated. E.P.V.

N65-19778* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion

PHASE DIAGRAMS OF THE SYSTEMS MgF_2-MgO, MgF_2-CaO

Geoffrey Belton and Ram A. Sharma *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965 10 p refs (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The acceptably large values of the heat of fusion of calcium oxide and magnesium oxide prompted an investigation of the phase diagrams of the binary systems MgF_2–CaO and MgF_2–MgO by differential thermal analysis. Eutectic composition and temperatures were determined for the systems. Results indicate the formation of true eutectic systems. E.P.V.

N65-19779* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion

TRANSIENT MEASUREMENT OF THERMAL DIFFUSIVITY OF REFRACTORY MATERIALS AT HIGH TEMPERATURE

Manfred Altman and H. Chang *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965. 16 p refs (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The previously developed unsteady-state method for measuring thermal diffusivity of solid refractory mixtures imposes a boundary condition which can be experimentally realized and precisely monitored through the use of an electrical feedback system. The method consists of heating the outer surface of a long cylindrical sample from an initial temperature T_i to final temperature T_f in a given time interval Δt, at a constant rate of temperature increase. The transient temperature rise along the axis of the sample from the same initial temperature T_i is fixed by its geometry and diffusivity. The difference in temperature rise between the surface and the axis of the sample as a function of time is utilized for the measurement of diffusivity. E.P.V.

N65-19783* Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion

TRANSIENT CONCENTRATION VARIATION IN NATURAL CONVECTION ELECTROLYSIS

Leonard Nanis *In its* [Res. in the Conversion of Various Forms of Energy by Unconventional Tech.] 4 Jan. 1965 18 p refs (See N65-19776 09-34) CFSTI: HC $3.00/MF $0.75

The development of a rapid method to be used in combination with microprobes located within a model pore region is discussed. The fundamental parameter is the thickness of the electrolyte layer, which becomes depleted of dissolved electroactive species, for constant local current density operation. The analysis of the transient behavior of electrode–electrolyte interface concentration to be combined with a relation between concentration and over potential, so that polarization transients can be predicted for assumed values of boundary layer thickness, is also discussed. From the analysis presented it is implicit that the diffusion coefficient is independent of concentration and, for the thermal analog, that the fluid thermal diffusivity is independent of temperature. E.E.B.

N65-19806# Delaware Univ., Newark. Dept. of Mechanical Engineering

MASS TRANSFER COOLING IN HIGH-SPEED COUETTE FLOW OF AN ABSORBING-EMITTING GAS

J. L. Novotny, Y. Taitel, and J. P. Hartnett Mar. 1965 40 p refs Revised

(TR-39)

Temperature distributions and heat-transfer rates in high-speed Couette flow with mass transfer where the gas absorbs and emits radiative energy are reported. Physical properties are assumed constant. The walls of the model are black and the diffuse, nonscattering gas is assumed to have an index of refraction of one. Two different thermal boundary conditions are considered: one corresponding in boundary-layer flow to a hot free stream at a Mach 6 and the other to a cool free stream at Mach 12. The dimensionless conduction–radiation interaction parameter which governs the relative role of the radiative transport is varied over a wide range of values including those associated with pure convection and pure radiation. The results of the analysis for the limiting values of optical thickness are compared to the optically thick and thin approximations. The effect of the blowing rate on heat transfer is studied for representative values of the radiation parameters. Author

N65-19808# European Atomic Energy Community, Brussels (Belgium).

FUNDAMENTAL STUDIES OF FLUID FLOW AND HEAT TRANSFER IN FUEL ELEMENT GEOMETRIES. I: ANALYSIS OF FLUID FLOW AND HEAT TRANSFER IN A TRIANGULAR ARRAY OF PARALLEL HEAT GENERATING RODS

R. Nijsing, I. Gargantini, and W. Eifler Dec. 1964 104 p refs (EUR-2193.e) Available from Belg. Am. Bank and Trust Co., New York, Account No. 22.186: 125 Belg. Fr.

The present report deals with theoretical considerations on fluid flow and heat transfer for axial turbulent flow in noncircular channels. An analysis is proposed which may be used to evaluate flow resistance and mean heat-transfer characteristics associated with such geometries, and to establish the distribution around the channel periphery of several local hydrodynamic and thermal parameters, which comprise local coolant velocities, local shear stresses, local coolant temperatures and local heat-transfer coefficients. The system for which calculations were carried out is a triangular array of parallel heat-generating rods. The effect has been established which rod spacing, Reynolds number and Prandtl number have on fluid flow and heat transfer for this geometrical configuration. Two heat transfer boundary conditions have been considered: that of uniform heat flux around the rod periphery and that of uniform surface temperature around the rod periphery. Predictions of the analysis for conditions of laminar flow agree with results obtained in an exact manner. Author

N65-19848*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

OSCILLATORY COMBUSTION OF A LIQUID-OXYGEN JET WITH GASEOUS HYDROGEN

Marcus F. Heidmann Washington, NASA, Mar. 1965 26 p refs

(NASA-TN-D-2753) CFSTI: HC $1.00/MF $0.50

Time variations in combustion parameters are measured in a zone of oscillatory combustion to aid in formulating a model of the oscillatory–combustion process. The study centers on a single 0.028-inch-diameter liquid-oxygen jet reacting with diffusely injected gaseous hydrogen in a two-dimensional circular combustor. Instability is coupled with the first spinning transverse mode. A correlation of pressure and gas velocity shows a predominantly inphase relation approaching that of a plane traveling wave. Gas velocities agree with calculated values for an isentropic wave process using experimentally determined gas properties. Photographs of the liquid jet correlated with phase position in the wave show the response of the jet to its changing environment. Radiation surveys indicate energy release at and beyond the position of mass release from the jet. The distributed radiation pattern may be attributed to gas-phase mixing processes. A conceptual model of instability based on the observed parameter variation is presented. Energy addition to the wave is dependent on the mass released from the jet, gas mixing, and a concentration-dependent reaction process. The effect of mass release is amplified by a steady gas flow. Author

N65-19876# Electro-Optical Systems, Inc., Pasadena, Calif.

CONENSER HEAT REJECTION SYSTEMS Monthly Progress Report, 25 Feb.–24 Mar. 1962

Lance Hays 10 Apr. 1962 5 p

(Contract NAS7-11)

(NASA-CR-57501; EOS-1588-ML-17) CFSTI: HC $1.00/MF $0.50

Preliminary results obtained for mass flow ratios (liquid to vapor) ranging from 15 to 50 indicate the measured values

of pressure rise to agree to within 20% of those predicted by analysis. The maximum value of the ratio of pressure rise to injected liquid dynamic pressure attained during testing was 12 which occurred at a mass flow ratio of 13. The maximum absolute pressure rise tested was 27 psid which occurred at a mass flow ratio of 49. The latter test run resulted in a value of the ratio of pressure rise to injected dynamic pressure of 1.9. The multitube test unit was installed in the 10 kW test loop. Shakedown tests were initiated to check performance of newly installed temperature instrumentation and to assist in the formulation of test procedures. Author

N65-19878*# Electro-Optical Systems, Inc., Pasadena, Calif.
CONDENSER HEAT REJECTION SYSTEMS Monthly Progress Report, 1–30 Dec. 1961
Lance Hays 10 Jan. 1962 3 p
(Contract NAS7-11)
(NASA-CR-57499; EOS-1588-ML-14) CFSTI: HC $1.00/MF $0.50

Flow visualization through a transparent mixing section constructed of quartz, and high speed motion photography of the condensation process are reported. Flow rates of 3600 lb/hr liquid and 214 lb/hr vapor were tested. Previous maximums were 2000 lb/hr for liquid and 124 lb/hr for vapor. With these increases the maximum pressure rise attained was increased from 1.7 to 7.0 psid, which occurred at a value of mass flow ratio of liquid to vapor of 16. The pump bearings failed after 8 months operation. E.E.B.

N65-19879*# Electro-Optical Systems, Inc., Pasadena, Calif.
CONDENSER HEAT REJECTION SYSTEMS Monthly Progress Report, Jan. 1962
Lance Hays 10 Feb. 1962 10 p
(Contract NAS7-11)
(NASA-CR-57498; EOS-1588-ML-15) CFSTI: HC $1.00/MF $0.50

Stable performance, together with high pressure rise ratios of 1.0 to 2.9 was obtained over a wide range of variables with the former test section. Pressure rise results have deviated somewhat from the results of the analysis which was based on the assumption of constant pressure in the mixing chamber. These deviations are qualitatively explained by variations in the mixing section pressure profile. An analysis to include the case of varying pressure in this region has been initiated. Fabrication of the multitube jet condenser test unit is now 90% complete. Two additional failures of boiler heating elements have occurred. These failures were felt to be mainly due to aging of the heaters and damage to other electrical components received during a previous failure. All boilers have now been replaced. E.E.B.

N65-19884*# General Electric Co., Philadelphia, Pa. Space Sciences Lab.
HYPERVELOCITY HEAT TRANSFER STUDIES IN SIMULATED PLANETARY ATMOSPHERES Final Report
J. S. Gruszczynski and W. R. Warran Mar. 1964 195 p refs Prepared for JPL
(Contracts NAS7-100; JPL-950297)
(NASA-CR-57508) CFSTI: HC $5.00/MF $1.25

Stagnation point convective heat transfer was measured with a platinum calorimeter and thin-film gages in a simulated planetary atmosphere composed of 9% CO_2 and 91% N_2 over a range of flight velocities up to 45000 ft/sec. It was found that the composition of the CO_2–N_2 mixture does not have a large effect on experimental convective heat-transfer rates. Convective heat-transfer data obtained with gages of different materials indicate that the state of the stagnation point boundary layer can be such that the gage surface effects the observed heat-transfer rates. Stagnation point equilibrium total radiation measurements in 9% CO_2 and 91% N_2, for shock velocities between 22000 and 34000 ft/sec, were compared with the theoretical predictions of Breene, et al. The total radiation behind the incident shock for shock velocities between 20000 and 30000 ft/sec and spectral distributions of equilibrium and nonequilibrium radiation were measured in a 25% CO_2–75% N_2 mixture. D.E.W.

N65-19904*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEALED-FOAM, CONSTRICTIVE-WRAPPED, EXTERNAL INSULATION SYSTEM FOR LIQUID-HYDROGEN TANKS OF BOOST VEHICLES
Washington, NASA, Mar. 1965 161 p refs
(NASA-TN-D-2685) CFSTI: HC $5.00/MF $1.00

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N65-19905* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
INSULATION CONCEPT
Paul T. Hacker and Jack B. Esgar *In its* Sealed-Foam, Constrictive-Wrapped, External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 1–9 refs (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

Presently used insulation systems of internal and external insulation for liquid hydrogen tanks were reviewed, including jettisonable and nonjettisonable schemes with helium purging. The new system detailed consists of low density polyurethane foam, covered and hermetically sealed with a thin film laminate of Mylar and aluminum foil to provide a positive barrier against gases or liquids that might lower the thermal conductivity. The insulation panels are bound to the tank with a prestressed wrap of fiber glass roving, relieving the system from dependence on adhesive bonds or the cohesive or shear strength of the insulation. E.P.V.

N65-19906* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL CONDITIONS DURING TYPICAL BOOST TRAJECTORY
William H. Roudebush *In its* Sealed-Foam, Constrictive-Wrapped, External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 11–17 refs (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

A typical Atlas-Centaur trajectory was chosen as the basis for aerodynamic heating calculations of the approximate temperature and dynamic head to which the sealed wrapped insulation would be subjected. The calculated insulation temperatures provided a guide for experiments on aerodynamic heating effects, and the calculated heating rates were used for a gross comparison of the thermal performances of the sealed wrapped insulation in a jettisonable system. E.P.V.

N65-19907* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THERMAL CONDUCTIVITY TESTS OF INSULATION SYSTEM
Laurence J. Heidelberg *In its* Sealed-Foam, Constrictive-Wrapped, External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 19–27 ref (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

Thermal conductivity measurements were made in a flat-plate apparatus. The test samples were designed to evaluate the effects on overall conductivity of foam evacuation, panel edge sealant materials, a typical panel joint, and a lightweight low-conductivity fiber glass cloth separator used to increase the contact resistance. The sample panels were tested under compression to account for the effect of the constrictive wrap. All tests were conducted with liquid-hydrogen temperature on the cold side of the apparatus and near ambient temperature on the warm side, to approximate actual conditions. The average value of overall thermal conductivity in the direct-contact runs was 0.145 Btu-in./hr-ft^2 °R, at a mean temperature of 282° R. A reduction in thermal conductivity of one order of magnitude is possible if a gap can be maintained between the insulation and the cold wall. E.P.V.

N65-19908* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
IMPACT SENSITIVITY OF FOAM INSULATION IN PRESENCE OF LIQUID OXYGEN
Robert P. Dengler *In its* Sealed-Foam, Constrictive-Wrapped External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 29–40 refs (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

The results of impact and permeability tests indicate low fire/explosion hazard in the event of accidental impact under ground hold and launch conditions. The Mylar–aluminum–Mylar (MAM) laminates provide adequate sealing from cryopumping of air, and the low permeability of the foam ensures localization of any leak that should occur. The panels show high resistance to impact rupture, and the possibility of an oxygen-rich condition is already at a minimum. Should a reaction occur, the likelihood of extensive damage is small, since a sustained reaction occurred in only 1 of 40 tests on foam samples. E.P.V.

N65-19909* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FABRICATION AND TESTS OF INSULATED SUBSCALE TANKS
Porter J. Perkins, Jr., Mario A. Colaluca, Frank P. Behning, and Francis Devos *In its* Sealed-Foam, Constrictive-Wrapped External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 41–69 refs (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

Four insulation systems were designed and fabricated for subscale aerodynamic heating tests. Variations in panel bonding material, edge seal thickness, and addition of panel protuberances had little effect on thermal performance within the accuracy of the measurements. Both nylon and fiber glass were satisfactory as constrictive wraps; however, the fiber glass is capable of operating at higher temperatures. A perimeter plus grid pattern was as satisfactory as a full bond area in preventing cryopumping of air behind the panels. The hermetically sealed system withstood the external pressure decay associated with a launch trajectory without damage. Though some leaks were found in the seals of all samples tested, the effects were localized and had little or no influence on thermal performance. E.P.V.

N65-19910* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
AERODYNAMIC HEATING TESTS OF SEVERAL VARIATIONS OF INSULATION SYSTEM
Reeves P. Cochran, Volodymyr O. Bazarko, and Robert W. Cubbison *In its* Sealed-Foam, Constrictive-Wrapped External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 71–97 refs (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

Aerodynamic heating tests were conducted on several variations of the insulation system in the subsonic exhaust jet of a turbojet engine and in wind-tunnel streams up to Mach 2.0. The maximum temperatures and dynamic pressures encountered exceeded those of the assumed typical launch trajectory, though the airflow velocities were usually below trajectory conditions. The results indicated the necessity of special adaptations to the constrictive wrapping technique to maintain structural integrity in the presence of external protuberances on the propellant tank. One such adaptation was successfully demonstrated, which involves redirecting the wrap over two rows of pins. E.P.V.

N65-19911* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN, FABRICATION, AND APPLICATION OF INSULATION SYSTEM TO FULL-SCALE TANK
Porter J. Perkins, Jr., Clem B. Shriver, and Ralph A. Burkley (Goodyear Aerospace Corp.) *In its* Sealed-Foam, Constrictive-Wrapped External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 99–116 (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

The details of the lightweight insulation system design, fabrication, installation, and weight breakdown for the full-scale Centaur tank are presented. The full-scale insulation design, tooling, and fabrication were conducted concurrently with other development phases involving materials testing and application, and tests of subscale tanks. Application of the system to the full-scale tank was started only after material and application techniques had been finally determined from the subscale tank tests. Author

N65-19912* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
FULL-SCALE-TANK GROUND-HOLD TESTS

Howard F. Calvert, Porter J. Perkins, Jr., William C. Morgan, and Mario A. Colaluca *In its* Sealed-Foam, Constrictive-Wrapped External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 117–149 ref (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

The lightweight insulation system was applied to a full-scale Centaur vehicle tank. The tank consisted of two compartments, one for liquid oxygen (which was filled with liquid nitrogen for these tests) and one for liquid hydrogen. The data obtained in this investigation were restricted to the insulation on the cylindrical section of the hydrogen tank. Two long-time ground-hold tests were conducted to investigate the insulation-system conductivity by measurement of boiloff rates and to determine the pressure-rise rate with vent valves closed. The insulation was inspected after the completion of the investigation to determine any degradation that may have taken place. The detailed inspection of the insulation after the test is fully described. Author

N65-19913* National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SUMMARY OF INVESTIGATION

Jack B. Esgar and Paul T. Hacker *In its* Sealed-Foam, Constrictive-Wrapped External Insulation System for Liquid-Hydrogen Tanks of Boost Vehicles Mar. 1965 p 151–157 (See N65-19904 09-33) CFSTI: HC $5.00/MF $1.00

The concept of a sealed-foam, constrictive-wrapped, external insulation system for liquid–hydrogen tanks of boost vehicles was thoroughly investigated to evaluate its feasibility and practicality. The investigation included (1) an analytical study to establish pertinent launch environment parameters for use in design and testing, (2) the selection and evaluation of insulation materials, (3) insulation of subscale tanks for development of fabrication and application techniques and for thermal and mechanical testing in various environmental conditions, and (4) insulation of a full-scale Centaur vehicle liquid–hydrogen tank that was tested under ground-hold conditions. A comparison is presented between the payload weight penalties imposed by this lightweight nonjettisonable insulation system and a heavy jettisonable insulation system that has been test flown on a Centaur vehicle. Author

N65-19923*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

RADIATIVE TRANSFER IN A CLOUDY ATMOSPHERE

R. E. Samuelson Washington, NASA, Apr. 1965 91 p refs (NASA-TR-R-215) CFSTI: HC $3.00/MF $0.75

The equation of radiative transfer in the context of a partially thermally emitting, partially anisotropically scattering plane-parallel cloudy atmosphere is derived. The derivation allows an exact interpretation of the auxiliary quantities in the equation of transfer in terms of the Mie scattering parameters. Explicit solutions are given by the method of discrete ordinates in accordance with Chandrasekhar's procedure, and extended to include thermal emission at infrared wave lengths. Solutions restricted to plane-parallel layers bounded on both sides by a vacuum and characteristic of a phase function for single scattering independent of optical depth are referred to as solutions to the restricted problem. To extend the treatment to the general problem, a procedure wherein layers with different scattering properties are combined is developed in terms of the restricted solutions. Such quantities as the angular distribution of outgoing radiation and the net outgoing flux are consequences of these solutions. Author

N65-19964# Rocketdyne, Canoga Park, Calif. Research Dept.

EFFECT OF ROCKET ENGINE COMBUSTION ON CHAMBER MATERIALS. PART I: ONE-DIMENSIONAL COMPUTER PROGRAM Final Report, 1 Apr.–30 Nov. 1964

W. J. Rivers, R. Van Wyk, J. D. Seader, H. A. Friedman, and H. N. Chu Edwards AFB, Calif., AF Rocket Propulsion Lab., Jan. 1965 214 p refs

(Contract AF 04(611)-9714)

(R-6050, Pt. I; AFRPL-TR-65-13; AD-455560)

A detailed one-dimensional ablation model is developed which accounts for both surface and internal ablative mechanisms. A new analytical approach is utilized to solve the resulting set of nonlinear partial differential equations. The new technique involves the simultaneous application of the Biot variational procedure and numerical finite difference methods employing the Crank–Nicolson implicit procedure and including predictor–corrector techniques. The resulting analysis was programed in Fortran IV for automatic computation on the IBM 7094 digital computer. The accuracy of some of the procedures utilized in the computer program is verified by comparing the results of a sample problem with theoretical solutions obtained from the restricted ablation models of Medford, Grosh, Lee, and Hahn. Author

N65-19992# General Electric Co., Philadelphia, Pa. Space Sciences Lab.

CRITERIA FOR THE VALIDITY OF LOCAL THERMODYNAMIC EQUILIBRIUM

Douglas H. Sampson Dec. 1964 27 p refs

(Contract DA-28-017-AMC-595(A))

(R64-SD90; AD-612788)

With the use of the Seaton formulas for the collisional excitation and ionization cross sections, a simple equation is obtained giving the relation between the electron temperature T, electron density N_e, and the ionization energy I_i, required for a gas to be collision dominated (i refers to the most tightly bound level of importance for a given N_e and T). Then with the use of an approximate equation expressing I_i in terms of T and N_e, an approximate general equation giving the relation between T and N_e necessary for all elements to be collision dominated, is obtained. It is seen that at high temperatures very high electron densities are required for high Z elements to be collision dominated. The additional requirements for a nonoptically thin gas to be LTE (local thermodynamic equilibrium) and the conditions for an optically thick gas to be in LTE are also briefly discussed. Author

N65-20016# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

BIBLIOGRAPHY OF PUBLICATIONS ON THE SUBJECT OF HEAT AND MASS EXCHANGE

R. A. Dolinskaya 27 Nov. 1964 21 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 6, no. 12, 1963 p 127–134 (FTD-TT-64-395/1; AD-609136)

This short bibliography contains a variety of publications in the following fields: physics of low temperatures, plasma physics, thermonuclear reactions, general observations of heat and mass exchange, mathematical analytical methods, thermodynamics, experimental methods, phase conversion, chemical conversion, super high speed and drying processes, thermophysical and thermodynamic characteristics of various materials, heat conductors and determination methods, physics of high temperature processes and magnetic hydrodynamics, processes in nuclear reactors, and design processes and apparatus. G.G.

N65-20020# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTENSIFICATION OF HEAT EXCHANGE IN ELECTRIC FIELDS
I. T. Alad'yev and V. A. Yefimov 1 Mar. 1965 14 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 6, no. 8, 1963 p 125–132
(FTD-TT-64-934; AD-611861)

A literature review was made of thermal conductivity and convective heat exchange in electric fields. From this review it was concluded that investigation of heat exchange in electric fields is in its initial stages. The available experiments are devoted basically to the study of principal rules. They show that intensification of heat exchange under the effect of electric fields deserves attention. E.E.B.

N65-20056# General Dynamics/Astronautics, San Diego, Calif. Space Science Lab.
THE FAR FIELD OF A ROCKET EXHAUST JET AT LOW AND MODERATE ALTITUDES Scientific Report No. 1
F. P. Boynton Dec. 1964 53 p refs
(Contract 19(628)-4360; ARPA Order 8662; Proj. Defender)
(GDA-DBE64-067; AFCRL-65-66; AD-612018)

A method is given for predicting the flow field of a rocket exhaust plume at distances far removed from the nozzle exit at altitudes where afterburning of the exhaust is appreciable. The calculation combines a fluid mechanical analysis of turbulent mixing due to Libby with the adiabatic flame temperature calculation of Boynton and Neu. The eddy viscosity is determined from a consideration of conditions under which compressible turbulent flows appear to exhibit self-preserving behavior. Instructions are given for preparing input to two computer programs which are based on the analysis in this report. In two appendices, it is shown how the eddy viscosity constants may be derived from incompressible jet flow data, and a comparison of the results of the present calculation with experimental wind-tunnel rocket exhaust behavior is given. Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N65-18623# Chrysler Corp., Detroit, Mich. Missile Div.
ANALYSIS OF MAINTENANCE TASK TIME DATA Final Report, 17 Jun.–30 Sep. 1964
Griffiss AFB, N.Y., RADC, Dec. 1964 274 p
(Contract AF 30(602)-3229)
(RADC-TDR-64-373, Vol. II; AD-610742)

Maintenance-task-time data were researched from unscheduled maintenance actions recorded in the field during the operational phase of the JUPITER Weapon System (WS-315A-2) covering 3 years. Statistical information was computed as minimum time to repair, maximum time to repair, and mean time to repair (MTTR) data for individual components. These statistics were correlated with component identification both by function and Federal Stock Number. Active maintenance times were tabulated on alphabetical nomenclature listings of component-replaceable items grouped by weapon system summary—denoting overall system experience—and an end item summary—denoting specific applications within equipments. The active maintenance times were identified in these listings as to minimum, mean, and maximum time to repair levels. Component ancillary maintenance data were also tabulated on alphabetical nomenclature listings as a component–replaceable item summary with end item grouping. Author

N65-18751# Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, NO. 6, 1964
3 Mar. 1965 269 p refs Transl. into ENGLISH of the publ. Izv. Akad. Nauk, Otd. Tekhn. Nauk: Tekhn. Kibernetika (Moscow), no. 6, Nov.–Dec. 1964 p 3–184
(JPRS-28989; TT-65-30439) CFSTI: $6.00

Statistical simulation, search theory, programing, and automatic control systems applied to technology and education. For individual titles see N65-18752–N65-18773.

N65-18884# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 1, NUMBER 2
Feb. 1965 74 p refs Sponsored by DOD
(AD-455792)

CONTENTS:

1. MULTICAVITY RADIOMETER MASERS FOR STUDIES OF THE 21-cm HYDROGEN LINE S. G. Hibben p 1–6 refs (See N65-18885 09-16)
2. BIOLOGICAL AND MEDICAL ASPECTS OF MICROWAVES C. Dodge p 7–19 refs (See N65-18886 09-04)
3. SOVIET RESEARCH ON MICROWAVE POWER GENERATION, II. OPTIMALIZATION OF THE PERFORMANCE OF PLANOTRONS AND NIGOTRONS A. Iwanovsky p 20–28 refs (See N65-18887 09-10)
4. THE DEPENDENCE OF OPTIMAL CONTROL ON THE PARAMETERS OF THE CONTROLLED PROCESS L. Kacinskas p 29–32 refs (See N65-18888 09-10)
5. THE INFLUENCE OF MICROWAVES ON THE FUNCTIONAL CONDITION OF THE NERVE C. Dodge p 33–38 ref (See N65-18889 09-04)
6. GAS-PHASE RADIATION-INDUCED GRAFT POLYMERIZATION: A PREPARATIVE METHOD FOR COHERENT SEMICONDUCTING POLYMER BASED MATERIALS S. Markov p 39–43 refs (See N65-18890 09-26)
7. SCIENCE & TECHNOLOGY NOTES p 44–57 refs
8. CONFERENCES p 58–68 refs

N65-18910*# National Aeronautics and Space Administration, Washington, D. C.
[SPACE EXPLORATION AND WORLD LEADERSHIP] News Release
James E. Webb 3 Mar. 1965 25 p Presented at Cornell Univ., Ithaca, N.Y. Available from the Scientific and Technical Information Division

James E. Webb, Administrator of the National Aeronautics and Space Administration, describes briefly some of the newly acquired capabilities, and those expected to be acquired, in carrying out the currently approved NASA research program for this decade. The country's overall program in basic research on materials has increased almost 40% since 1962 with the help of NASA contracts and grants. A continuing effort must be made to keep basic research, and the applied research directed toward solution of known problems from drifting apart. The universities can make major contributions to the national

space program through creativity, initiative, and diversity of approach, and each participating university is encouraged to choose its own course. The active help of the university community to master the new environment of space is an important part in the government–industry–university partnership. G.G.

N65-19392*# National Aeronautics and Space Administration, Washington, D. C.
[THE ROLE OF NEW MEXICO IN ATOMIC ENERGY, IN AERONAUTICS, AND IN SPACE EXPLORATION] News Release
James E. Webb 19 Mar. 1965 29 p Presented at New Mexico Univ., Albuquerque Available from the Scientific and Technical Information Division

After reviewing the importance of New Mexico and the Albuquerque contribution to present day science and technology of space, rocketry, and atomic energy, James E. Webb, Administrator, NASA, summarized the events of the past year to illustrate the range and richness of the returns of the wide-ranging scientific technological advances. According to Mr. Webb, our new frontier is not merely space itself. It is all of the courage and work required to go there; it is the evolving knowledge of a part of nature never before reached; it is the new fuels, the surging rockets, the incredibly delicate guidance, it is the national commitment to science and technology through the whole structure of education, research, industry, and government. It is the task of our time to reaffirm and validate this nation's principles in the setting of this new frontier environment. E.E.B.

N65-19625# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
REPORT ON RESEARCH, 1 JANUARY 1962–30 JUNE 1964
Jul. 1964 193 p refs
(ARL-64-1; AD-609797) CFSTI: $3.00

Research in the physical and engineering sciences from January 1962 through June 1964 covered the following subjects: *Applied Mathematics*—mathematical physics, mathematical statistics, and numerical analysis; *General Physics*—atomic physics, general relativity and quantum field theory, nuclear structure physics, and quantum theory; *Solid State Physics*—basic mechanisms, and electrical and optical properties of the II–VI semiconductor compounds; *Chemistry*—properties, structure, and reactions of chemical substances, molecular transport phenomena, energy exchange in radiolytic and photolytic processes, chelate chemistry, high temperature thermodynamics and kinetics, and organosilicon chemistry; *Metallurgy and Ceramics*—defect structure and transport properties of ceramics; *Plasma Physics*—high energy as well as low energy plasma studies; *Thermomechanics*—energy exchange and heat transfer energy conversion, and mechanics of structures; *Hypersonic Research*—theoretical and experimental gas dynamics; and *Fluid Dynamics*—hypersonic aerodynamics. G.G.

N65-19695*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SCIENTIFIC EXPLORATION OF SPACE AND ITS CHALLENGES TO EDUCATION
Harry J. Goett [1964] 27 p Address Presented at Centennial Convocation Luncheon, Worchester Polytech. Inst., Mass.
(NASA-TM-X-56149) CFSTI: HC $2.00/MF $0.50

Dr. Harry J. Goett, National Aeronautics and Space Administration, points out the growing need for closer interdisciplinary collaboration between scientific specialists in various fields and the engineers in our space efforts, with emphasis on meteorological satellite observations. Our educational processes should be reexamined to insure a curriculum that furthers interdisciplinary collaboration of various scientific specialists, provides leadership of the engineer in developing new techniques to enable the scientist to achieve his objectives in space, and develops the creative thinking which is required to apply the new developments of space to our civilian economy. G.G.

N65-19712*# Federal Council for Science and Technology, Washington, D. C.
TECHNICAL INFORMATION AND THE FEDERAL LABORATORY
[1964] 97 p refs Proc. of 2nd Symp. held at Goddard Space Flight Center, Greenbelt, Md., 13–14 Apr. 1964 GPO: $0.65

In this report on a symposium on scientific and technical information, the needs for systematic communication and availability of information are discussed. Topics discussed are (1) the relationship between creative work and information gathering, (2) the need for better packaging of information, (3) some means of achieving higher group productivity, and (4) the importance of information routing through research and development personnel. Case studies in each of these four areas are presented. J.M.D.

N65-19739*# National Aeronautics and Space Administration, Washington, D. C.
[ELECTRONICS IN TRANSITION AS RELATED TO NASA PROGRAMS] News Release
James E. Webb 3 Feb. 1965 16 p Presented at the Mil. Electron. Conv., Los Angeles, 3 Feb. 1965

James E. Webb, National Aeronautics and Space Administration, discusses the status of the NASA programs for electronics in transition, the relationship between the various programs, the electronics industry and the involvement of that industry in the NASA programs, and the utilization of the future Electronics Research Center in Cambridge, Massachusetts. G.G.

N65-19744*# National Aeronautics and Space Administration, Washington, D. C.
THE CHALLENGE AND PROMISE OF THE SPACE AGE News Release
James E. Webb 25 Jan. 1965 16 p Presented at Miami Univ., Coral Gables, Fla., 25 Jan. 1965

James E. Webb, National Aeronautics and Space Administration, presents the complex interdevelopment of technical power and of the social organization necessary to control, direct, and exploit the space developments of the space age. A realistic, mutually valuable, scientifically valid cooperation in connection with our space programs is necessary with foreign countries and scientists. These international aspects of the space age are positive in character and hold promise for joint enterprises, for political accommodations, and for the extension of very real benefits to the developing countries. G.G.

N65-19750*# Missouri Univ., Columbia. Research Center
SCIENTIFIC RESEARCH IN MISSOURI
Donald A. Murry Feb. 1965 106 p refs *Its* Ser.-5
(Grant NGR-26-004-012)
(NASA-CR-57232) CFSTI: HC $4.00/MF $0.75

Missouri's scientific research activities, recent expansion of research and development activity in the United States, expansion of scientific research in Missouri, scientific talent in regional research and development expansion, and scientific talent resources in Missouri and selected states are reviewed.

It was concluded: (1) Despite the dominance of an individual state industrial contractor in space research, there appears to be little overall strength in research and development at this time in Missouri. (2) If a viable scientific research industry is sought for Missouri, the role of catching up indicates that a considerable quantity of scientific resources, with some specific characteristics, must be made available. E.E.B.

N65-19759*# National Aeronautics and Space Administration, Washington, D. C.
SCIENCE AND TECHNOLOGY IN TRANSITION
Raymond L. Bisplinghoff [1964] 12 p Presented at the U. C. Day Banquet, Cincinnati, 15 Apr. 1964
(NASA-TM-X-56148) CFSTI: HC $1.00/MF $0.50

Dr. Raymond L. Bisplinghoff, National Aeronautics and Space Administration, describes the agency's space research responsibilities. Future developments in regard to supersonic transports, airbreathing propulsion, vertical and short takeoff and landing, weight lifting capabilities of the Saturn V boosters, and, finally, a lunar landing are briefly discussed. G.G.

N65-19776*# Pennsylvania Univ., Philadelphia. Inst. for Direct Energy Conversion
[RESEARCH IN THE CONVERSION OF VARIOUS FORMS OF ENERGY BY UNCONVENTIONAL TECHNIQUES] Status Report
4 Jan. 1965 99 p refs
(Grant NsG-316)
(NASA-CR-57331; INDEC-SR-5) CFSTI: HC $3.00/MF $0.75

CONTENTS:

1. PARTIAL MOLAR PROPERTIES OF MAGNESIUM BASE BINARY THERMAL ENERGY STORAGE SYSTEMS G. Belton and Y. Rao 9 p refs (See N65-19777 09-33)
2. PHASE DIAGRAMS OF THE SYSTEMS MgF_2–MgO, MgF_2–CaO G. Belton and R. A. Sharma 10 p refs (See N65-19778 09-33)
3. TRANSIENT MEASUREMENT OF THERMAL DIFFUSIVITY OF REFRACTORY MATERIALS AT HIGH TEMPERATURE M. Altman and H. Chang 16 p refs (See N65-19779 09-33)
4. EMITTER SURFACE PHYSICS OF PLASMA DIODES L. W. Zelby, G. L. Schrenk, and M. Kaplit 7 p refs (See N65-19780 09-03)
5. EMITTER SHEATH POLARITY IN PLASMA DIODES G. L. Schrenk 13 p refs (N65-19781 09-03)
6. INVESTIGATION OF Na-K SEEDED ARGON PLASMA H. Yeh, C. F. Gottschlich, and T. K. Chu 7 p (See N65-19782 09-25)
7. TRANSIENT CONCENTRATION VARIATION IN NATURAL CONVECTION ELECTROLYSIS L. Nanis 18 p refs (See N65-19783 09-33)

N65-19789# Air Force Systems Command, Andrews AFB, Md.
CONFIGURATION MANAGEMENT DURING DEFINITION AND ACQUISITION PHASES: SYSTEMS MANAGEMENT
B. A. Schriever 1 Jun. 1964 368 p Supersedes previous AFSCM-375-1 manuals
(AFSCM-375-1) GPO: $3.50

This manual describes the management interface between the industrial and government members of the acquisition team, and serves as an effective management tool for program managers to establish policy, provide guidance, and assign responsibilities for configuration management of system/equipment programs. The following topics are presented: *Configuration Management by the Air Force Systems Command; Configuration Management within the System Life Cycle; Government—Industrial Contractor Interface*; and *Summary*. Appendixes contain instructions for preparation of contract specifications, detail specifications, and report requirements. G.G.

N65-19831# Lockheed Missiles and Space Co., Sunnyvale, Calif.
LONG-RANGE PLANNING AND TECHNOLOGICAL FORECASTING: AN ANNOTATED BIBLIOGRAPHY, SUPPLEMENT I
Peter R. Stromer, comp. Feb. 1965 40 p refs
(LMSC-5-10-65-3; SRB-65-1)

Emphasis is on planning within the aerospace and defense industry. During the past year both industry and government conducted introspective studies on such topics as potential convertibility of admitted industry overcapacity to peaceful pursuits and the economic impact of reductions in defense spending. Desirable diversification strategies and goals were rigorously assessed. While general conclusions may be lacking, sufficient data are available to aid in the decision-making process. Author

N65-19843# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center
METHODS OF CONTROLLING AND EXTINGUISHING TITANIUM FIRES
D. J. Maykuth Jul. 1964 7 p refs
(AD-609341)

The report summarizes available information on prevention, control, extinguishment, and hazards of fires connected with titanium storage. Two effective extinguishing agents are compared. The first is a powder consisting of sodium chloride with additives including tricalcium phosphate and metal stearates; the second is an organic liquid, trimethosyboroxine. A graphitized foundry coke is also described for this purpose. E.P.V.

N65-19881*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PUBLICATIONS OF THE JET PROPULSION LABORATORY, JULY 1963–JUNE 1964
Joe Dyer, Jr. 31 Aug. 1964 63 p refs
(Contract NAS7-100)
(NASA-CR-57494; JPL-BIBL-39-5) CFSTI: HC $3.00/MF $0.75

Technical reports on a single significant development, on the completion of a recognizable phase, or on the completion of an entire project are reviewed. Also, technical memorandums, reporting the results of special studies, are included. Additionally, research activities in the field of nondestructive testing of solid-propellant rocket motors are summarized in a quarterly summary report, which is indexed. Other publications, literature searches, translations, and numerical index of technical reports are included. E.E.B.

N65-19884*# George Washington Univ., Washington, D. C.
SCIENCE IN NATIONAL POLICY—A PRELIMINARY INQUIRY Paper No. 1
Vincent P. Rock Nov. 1964 43 p refs Speech given in 1964 1965 Distinguished Lecture Ser., Sci., Bur. of Metropol. Washington Board of Trade, 21 Oct. 1964
(Grant NsG-727)
(NASA-CR-57428) CFSTI: HC $2.00/MF $0.50

To attain our goal of the "great society" we must have science in policy. This involves large-scale support of fundamental research in the social as well as the physical sciences. Scientific knowledge must be organized and applied to the major problems of national and international life. New means are required for rapidly diffusing the scientific knowledge needed in daily life. Society needs better methods for making the strategic choices between present desires and future needs, between individual acquisition and social progress. Finally, scientific knowledge is essential to permit the sustained development of a viable sense of community. Each of these elements of science in policy is examined with a view to suggesting new directions for action. Author

N65-19898*# George Washington Univ., Washington, D. C.
SCIENCE, TECHNOLOGY, AND THE NATIONAL POSTURE Note No. 1
Addison M. Rothrock Dec. 1964 10 p refs
(Grant NsG-727)
(NASA-CR-57435) CFSTI: HC $1.00/MF $0.50

The major importance of the nation achieving preeminence in technology and science is the keynote of the speech. Three major break-throughs are mentioned: nuclear power, the transistor, and manned space flight. The achievements of the space program, the cost and its potential for the future are discussed. The nation must grasp the fundamental fact that great discoveries will require public support and therefore public understanding before they can be brought to fruition. E.E.B.

N65-19959*# Midwest Research Inst., Kansas City, Mo.
OPPORTUNITIES FOR THE PRACTICAL USE OF SPACE TECHNOLOGY BY BUSINESSMEN
Charles N. Kimball [1961] 11 p Sponsored by NASA
(NASA-CR-60784) CFSTI: HC $1.00/MF $0.50

A project for speeding up the flow of space program technical advances to industry in six Midwestern states is described. The primary purpose is to communicate space technological advancements to industry so that present manufacturing techniques may be improved and new products and markets developed. Several cases are presented in which space technology is benefiting industry. N.E.A.

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Texas: Fort Worth, San Antonio
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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

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